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Introduction

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **491**

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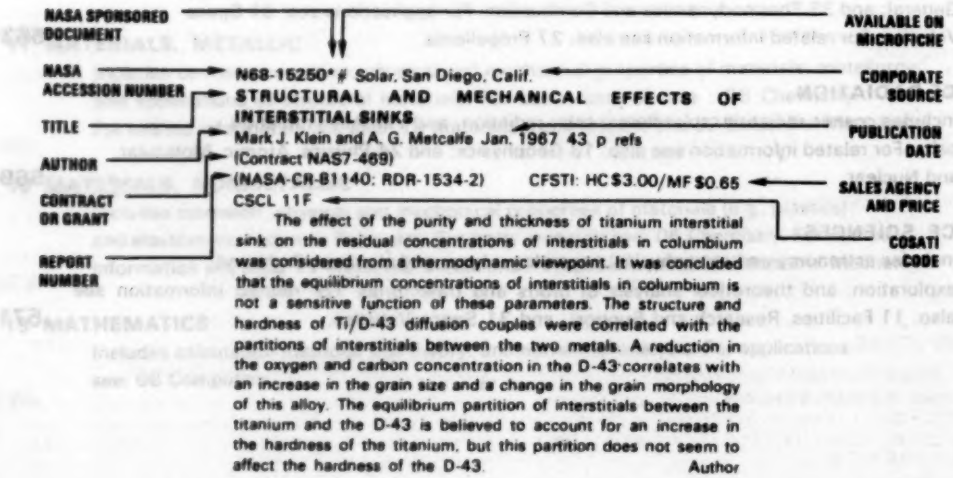
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43.
Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N68-12825# France. Service Technique de l'Aeronautique, Paris.
STUDY OF AERODYNAMICS AND AEROTHERMODYNAMICS OF CIRCULAR CYLINDERS AT OBLIQUE ATTACK IN SUPERSONIC FLOW [ETUDE AERODYNAMIQUE ET AEROTHERMIQUE DE CYLINDRES CIRCULAIRES EN ATTAQUE OBLIQUE DANS UN ECOULEMENT SUPERSONIQUE]
Gia Ban Diep 1967 107 p refs In FRENCH
(Rept.-432)

Circular cylinders were studied at oblique attack angle in supersonic flow at Mach number 2.42. Pressure coefficients were determined, and the Mach number at the exterior boundary layer was explored. Friction temperatures, effective temperature, convection coefficients, and thermal factors related to friction and convection were determined. Transl. by M.W.R.

N68-12834 National Physical Lab., Teddington (England). Aerodynamics Div.
THE STRUCTURE AND BEHAVIOUR OF LAMINAR SEPARATION BUBBLES
M. Gaster 13 Mar. 1967 37 p refs
(NPL-AERO-1181; ARC-28226)

A study has been made of laminar separation bubbles formed over a wide range of Reynolds numbers and in a variety of pressure distributions. The structure of the bubble depended on the value of the Reynolds number of the separating boundary layer and a parameter based on the pressure rise over the region occupied by the bubble. Conditions for the bursting of 'short' bubbles were determined by a unique relationship between these two parameters. Hot-wire measurements of both mean and fluctuating velocity in the separated region, together with oscilloscope records of the fluctuations, explain some of the flow mechanisms involved. Author

N68-12848 Aeronautical Research Council (Gt. Brit.).
MEASUREMENTS OF DRAG, BASE PRESSURE AND BASE AERODYNAMIC HEAT TRANSFER APPROPRIATE TO 8.5° SEMI-ANGLE SHARP CONES IN FREE FLIGHT AT MACH NUMBERS FROM 0.8 TO 3.8
G. H. Greenwood London HMSO 1967 50 p refs Supersedes RAE-TR-66394; ARC-29060; see X67-18646
(ARC-CP-958; RAE-TR-66394; ARC-29060; AD-813666) HMSO: 10s

Measurements of drag, base pressure and aerodynamic heat transfer have been made on a sharp cone in free flight at Mach numbers up to 3.8 and free stream Reynolds numbers up to 77 millions based on cone length. The drag and base pressure measurements were in good agreement with estimates. The heat transfer data were however degraded by deficiencies in the construction of the thermocouples. Nevertheless they did show that the aerodynamic heat flux was uniform over the base. In particular there was no evidence of high values at the rear stagnation point. Author (TAB)

N68-12905 Aeronautical Research Council (Gt. Brit.)
AN INVESTIGATION INTO A TECHNIQUE FOR MEASURING JET INTERFERENCE EFFECTS USING FREE-FLIGHT MODELS
G. H. Greenwood London HMSO 1967 19 p refs Supersedes RAE-TR-66364; ARC-29039 See X67-17557
(ARC-CP-969; RAE-TR-66364; ARC-29039) HMSO: 4s

A free flight model investigation is described, the major object of which was to gain design and operational experience in the field of jet interference studies. Measurements were made of the effect of a propulsive jet on the external drag of a boattailed body of revolution but because of uncertainties in the jet performance these measurements are of significance only in illustrating the experimental technique. A solid fuel rocket motor was used as the primary source of the jet flow. Author

N68-12912 Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF MOMENTUM THICKNESS IN A TURBULENT BOUNDARY LAYER AT MACH NUMBERS UP TO UNITY
J. F. Wash and A. G. J. Macdonald London HMSO 1967 36 p refs Supersedes NPL-AERO-1207; ARC-28235 See X67-17080
(ARC-CP-963; NPL-AERO-1207; ARC-28235) HMSO: 6s 6d

For boundary layers of a class which includes those developing in rooftop pressure distributions, the small departures from local equilibrium which occur are shown to have an even smaller effect on the growth of momentum thickness. The assumptions of precise local equilibrium thus provides a simple but accurate basis for predictions of momentum thickness, and a calculation method is formulated accordingly. Author

N68-12913 Aeronautical Research Council (Gt. Brit.)
MEASUREMENTS AT TRANSONIC SPEEDS OF THE SIDEFORCE AND YAWING MOMENT ON VARIOUS STORE ARRANGEMENTS MOUNTED BENEATH A 45° SWEPT WING–FUSELAGE MODEL
P. Marsden and A. B. Haines London HMSO Jun. 1964 110 p refs Supersedes ARA-WTN-49; ARC-26204
(ARC-CP-955; ARA-WTN-49; ARC-26204) CFSTI: $3.00

Tests have been made in a 9×8 ft transonic tunnel on a streamlined store-pylon arrangement mounted in various locations beneath a 45° swept wing–fuselage model. Six-component measurements of both the loads on the store including pylon-induced effects, and of the total store plus pylon loads have been obtained for Mach numbers from M=0.60 to M=1.41. The full sideforce and yawing moment results are given. These are analyzed in detail and related to the likely sidewash field beneath the wing at both subsonic and supersonic speeds, as obtained from other sources. The experimental sideforce results, compared with estimates based on an empirical method, show that certain changes in the empirical method are desirable. The unpublished results of some ad hoc tests at transonic speeds on winged missiles mounted beneath both a 60° delta and a 40° swept-back wing are given in order to emphasize the dangers in using the empirical method for stores which have significant wing-type lifting surfaces. Author

N68-12947 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
AN ANALYTIC AND EXPERIMENTAL STUDY OF JET DEFLECTION IN A CROSS-FLOW
C. T. Crowe and H. Riesebieter [1965] 21 p refs

An equation based on a simple theoretical model was derived for jet trajectories as a function of the jet cross-flow dynamic pressure ratio. Important data lacking in the analysis was the rate at which the jet spreads out in the direction normal to the cross-flow. A smoke tunnel study was undertaken to determine the spread-rate factor. Data on the smoke trajectories within a deflected jet and the dynamic pressure along the jet were reduced to provide the desired information. Application of the smoke tunnel data to the analysis resulted in an equation for jet trajectories which agrees with experimental results over a wide range of dynamic pressure ratios. Author

N68-12951# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
INFLUENCE OF MACH NUMBER ON THE HYPERSONIC FLOW OVER A TRIANGULAR WING WITH BLUNTED EDGES [VLIYANIE CHISLA MAKHA NA GIPERZVUKOVOE OBTEKANIE TREUGOL'NOVO KRYLA S PRITUPLENNYMI KROMKAMI]
A. V. Krasil'nikov Nov. 1967 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. Zhidkosti i Gaza (Moscow), no. 1, 1967 p 101–106
(TR-44)

A solution is obtained for the flow over a blunted triangular plate at a large, but finite, Mach number using a simple two layer analysis of the flow. The pressure distribution on the plate, thickness of the entropy layer and mean velocity unit, and the shape of the shock wave are calculated. Author

N68-12999
ROTOR INDUCED FLOW
A. R. Seed [1967] 28 p refs

Circulation control by blowing permits generation of very high lift coefficients on a circular section aerofoil. A lifting rotor equipped with such a section can generate high thrust coefficients with comparatively few blades. An experimental investigation by hot wire anemometers on a two-bladed rotor shows that the induced velocity at the rotor disc has a periodic component which increases with rotor thrust coefficient. This periodicity is only adequately predicted theoretically by considering the actual trailing vortex system of the rotor. Vortex theory is also used to give an indication of the induced flow field in forward flight. The conclusions drawn from these analyses of the circulation-controlled rotor are shown to apply to conventional rotors operating at comparable loadings. The use of an electromagnetic analog for induced flow measurements is briefly discussed. Author

N68-13007# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
NOSE BLUNTNESS, CONE ANGLE, AND MACH NUMBER EFFECTS ON THE STABILITY DERIVATIVES OF SLENDER CONES Final Report
James T. Clay Sep. 1967 46 p refs
(ARL-67-0185; AD-661549)

A theoretical and experimental study to evaluate the influence of spherical nose bluntness, of cone angle, c. g. location and Mach number on the stability characteristics in pitch of blunt slender cones was conducted. A 10-degree half-angle cone with nose bluntness ratios from .025 to .30 was investigated. The observed effect of the nose bluntness on the stability derivatives was quite similar to earlier results with a 5.6 degree half-angle cone. Again, a severe breakdown of the damping derivatives was found for large bluntness ratios. An estimate of the pitch-induced angles of attack for large bluntness ratios was based on the physics of the blast wave type flow. It was found that these induced angles differ from those applicable for pointed cones or for small bluntness ratios where the flow has mainly conical character. The tangent cone method in connection with these different types of pitch-induced angles of attack qualitatively predicts the observed breakdown of the damping derivatives. Author (TAB)

N68-13009# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
FLOW INVESTIGATION ABOUT A FIN PLATE MODEL AT A MACH NUMBER OF 11.26 Final Report, Aug. 1963–Jun. 1967
John P. Thomas Sep. 1967 69 p refs
(ARL-67-0188; AD-661548)

The purpose of the investigation was to study the flow fields at M = 11 about a hemicylindrically blunted flat plate and four interchangeable fins which were attached to the plate. Two of the fins had hemicylindrical leading edges; one fins leading edge was unswept while the other had a 45 degree sweep. The remaining two fins had sharp leading edges with one unswept and the other swept 45 degrees. The plate was varied in angle of attack from compression 10 degrees to expansion 10 degrees while the fins yaw angle was varied from 0 degrees to 10 degrees. Five methods were utilized in the work. Static pressures were measured on the plate surface. Silicone oil flow studies were made on the fin and plate surfaces. A liquid flow visualization mixture was employed on the model surface to help distinguish the direction of flow, the separation areas, and reattachment regions. A vapor screen technique was utilized to help define the plate and fin shock locations and shapes. An equation was found for the variation of the shock shape of the hemicylindrical blunted plate from M = 3 to M = 20. The equation is based on the blast wave analogy. Author (TAB)

N68-13016*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SOME CONSIDERATIONS IN WIND-TUNNEL TESTS OF V/STOL MODELS
Harry H. Heyson 1967 60 p refs Presented at the Univ. of Tenn. Space Inst., Tullahoma, Tenn., 29 Sep. 1967
(NASA-TM-X-60772) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Considerable care is required in applying wall interference corrections to V/STOL data. The following items comprise a minimum list of features which should be considered: type of tunnel and proportions, effective wake skew angle, span of both lifting system and tail, configuration, model location, tail length and height, angle of attack, pivot location, and center-of-gravity location. Auxiliary balances may be required to obtain the forces of each component in complex lifting systems. Some discrepancies may remain, largely because of the imperfect knowledge of the aerodynamics of many V /STOL configurations. The boundary layer on the tunnel floor requires careful consideration, particularly in ground-effect testing. Recirculation will limit the minimum speeds at which successful data can be obtained. Many questions, such as the effect of angular and velocity rates, remain to be answered in evaluating V/STOL testing techniques. Author

N68-13058 Royal Aircraft Establishment, Farnborough (England).
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 3: AIRCRAFT DYNAMICS
H. R. Hopkin Jun. 1966 82 p ref
(RAE-TR-66200, Pt. 3)

Nomenclature and notation for equations of motion for a rigid object of constant mass are presented and discussed. Longitudinal and lateral stability and response quantities are considered, along with characteristics of linear dynamic systems. Expressions are also presented for centers of force and their relation to control discriminants. N.E.N.

N68-13059 Royal Aircraft Establishment, Farnborough (England).
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 2: BASIC NOTATION AND NOMENCLATURE
H. R. Hopkin Jun. 1966 68 p ref
(RAE-TR-66200, Pt. 2)

A scheme of standard notation and nomenclature applicable to both airplanes and missiles is proposed. The terms relating to systems of axes, attitude angles, and direction angles are defined, and notation is indicated. Notation is also given for components of kinematic equations and expression of the relations between aircraft attitude, incidence and attitude of air-path axes. Standard symbols for the constants of inertia are also presented. N.E.N.

N68-13128 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
AERODYNAMIC STUDY OF HELICOPTER BLADE SECTIONS [ETUDE AERODYNAMIQUE D'UN ELEMENT DE PALE D'HELICOPTERE]
Philippe Poisson-Quinton and Alexandre de Sievers 1967 35 p refs In FRENCH; ENGLISH summary Presented at the AGARD Meeting, Gottingen (W. Germany), 11–13 Sep. 1967
(ONERA-TP-495(1967))

For the aerodynamic calculation of a helicopter rotor, it is necessary to know the two-dimensional aerodynamic characteristics of blade airfoil sections. Here, the main goal is to increase the maximum lift (retreating blade at a Mach number from 0,2 to 0,4), and to reduce the drag (advancing blade at M from 0,7 to 1), both subjected to compressibility effects at high forward speed. A special mounting for two-dimensional transonic investigations is being built at the variable-density S3 MODANE wind tunnel, to simulate the local Mach and Reynolds numbers of a modern rotor in flight. Research in incompressible flow has dealt with the effect of manufacturing imperfections of a real helicopter blade and with the maximum lift and L/D improvements by means of a cambered nose section covering the actual symmetric airfoil. Calculation of the symmetrical and cambered profiles was carried out by rheoelectric methods in incompressible perfect flow. The good agreement between the electrical analogy computations and the experimental results shows that this method is useful for fast optimization of a family of profiles corresponding to given criteria. Author

N68-13135 Royal Aircraft Establishment, Farnborough (England).
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 1: GENERAL
H. R. Hopkin Jun. 1966 93 p refs
(RAE-TR-66200, Pt. 1)

A scheme of notation and nomenclature applicable to the dynamics and associated aerodynamics of both airplanes and missiles is proposed. The proposals are intended to supersede the attempts made to revise and extend the existing standard reference in this field. Author

N68-13138 Royal Aircraft Establishment, Farnborough (England).
AN EXPERIMENTAL AND THEORETICAL COMPARISON AT M=4 OF THE LIFT-TO-DRAG RATIO OBTAINED BY INTERFERENCE BETWEEN VOLUME, LIFTING SURFACE AND POWERPLANT, WITH THAT OBTAINED BY THE INTEGRATION OF THE VOLUME AND POWERPLANT ELEMENTS
C. S. Brown and E. L. Goldsmith Mar. 1967 48 p refs
(RAE-TR-67067)

An experimental and theoretical comparison has been made between two different methods of combining excess cross-sectional area (due to the engine exhaust nozzle exit being larger than the intake entry) with the volume and lifting surface elements in an aircraft configuration. Comparisons of measured and calculated values of $(L/D)_{max}$ have been made using linear theory and in general fair agreement is achieved. A systematic study of the effect of varying the proportions of the configurations studied leads to finding the optimum proportions for either approach. Author

N68-13141# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ANALYSIS OF EXPERIMENTS ON HYPERSONIC FLOW SEPARATION AHEAD OF FLAPS USING A SIMPLE FLOW MODEL
W. G. Hill, Jr. Nov. 1967 67 p refs
(RM-383)

Data from a series of tests of flat plates with trailing edge flaps are analyzed in detail. Tunnel Mach numbers were 5 and 8 and free stream Reynolds number ranged from 1×10^6 to 7×10^6. Only those tests where the boundary layer was laminar at separation are reported herein. In many cases studied, transition occurred at or before reattachment, but cases where the boundary layer was turbulent before separation are not included. Plateau pressures for these high Mach number tests are shown to agree quite well with an existing correlation of lower speed data. A method for calculating the pressure distribution when the separation point is known is developed and used in analysis of the data. Waves reflected from the intersection of the separation and reattachment shocks are shown to have a significant effect on the pressure distribution under certain circumstances. The leading edge shock may also interact with the separation shocks; here too, the reflected waves can greatly alter the pressure distribution. However, this condition was not examined. The variation of the separation location with test parameters is presented and the problem of predicting separation is discussed. Author

N68-13151 National Research Council of Canada, Ottawa (Ontario).
MEASUREMENTS OF THE INFLUENCE OF MIXED BOUNDARIES ON THE AERODYNAMIC CHARACTERISTICS OF A V/STOL WIND TUNNEL MODEL

P. South [1967] 19 p refs

The relatively large wall effects that occur in wind tunnel tests of V/STOL models require that either the corrections must be accurately known, or that some method of reducing the wall effects is used. Measurements of the wall effects in an open and in a closed wind tunnel are compared with existing theory and a series of tests of working sections with mixed boundaries are described in an effort to reduce the wall effects. Lift, drag, pitching moment, propeller thrust, and flow angle in the region of the tailplane were measured for a twin propeller tilt wing aircraft model. For the completely open and completely closed working sections, the results are compared with the corrections predicted by Heyson's method. The tests in the mixed boundary working sections show that it is possible to greatly reduce the effect upon angle of attack by using suitable working sections and that it is also possible to modify the dynamic pressure effects but that mixed boundaries are not as effective in reducing the latter effects. Author

N68-13153 Bell Helicopter Co., Fort Worth, Tex.

ROTARY WING BOUNDARY LAYER AND RELATED RESEARCHES

W. H. Tanner [1967] 16 p refs

Reported are experimental studies on the boundary layer of a hovering rotor and related effects such as the forming tip vortex and stall. In forward flight, initial studies of radial flow effects were made. The techniques employed include flow visualization by means of an evaporative chemical, hot wire anemometer and special pressure instrumentation. Information is presented for hovering on the transition from laminar to turbulent flow, surface conditions, boundary layer flow direction, both unstalled and stalled, and other aerodynamic characteristics. Testing was conducted on model and full-scale helicopter rotors in the open atmosphere and in wind tunnels. Nonrotating simulation studies were also made and preliminary results are reported. In conjunction with the experimental work, theoretical analysis has or is being developed to explain the observed phenomena. Where applicable, theory-experiment comparisons are presented and discrepancies between present widely accepted theoretical techniques and the experimental results are noted. Author

N68-13155 Aeronautical Research Council (Gt. Brit.)

THE EFFECT OF BASE BLEED ON THE BASE PRESSURE OF SEVERAL SHROUDED AND UNSHROUDED PROPELLING NOZZLES AT $M_\infty = 1.96$

M. M. Shaw London HMSO 1967 84 p refs Supersedes RAE-TR-66182; ARC-28721 See N67-34735

(ARC-CP-962; RAE-TR-66182; ARC-28721)

Base pressure measurements have been made on a bluff area surrounding a propulsive jet with and without base bleed. The effects of altering the jet Mach number and the ratio of jet exit area to total base area have been indicated. The tests were extended to measuring base pressure inside a shroud, and a correlation between the unshrouded and shrouded results is obtained. The results from the shrouded tests are compared with those from simple one-dimensional theories, with some success. Calculations of thrust efficiency show that high values can be obtained with the right combination of nozzle design Mach number, bleed flow, and jet to maximum area ratio. If air of low total head, e.g. from an intake bleed, has to be disposed of, then feeding it into a duct surrounding a shrouded jet nozzle can be an efficient means of disposal. Author

N68-13156 Aeronautical Research Council (Gt. Brit.)

THE VELOCITY FIELD NEAR NON-LIFTING DELTA WINGS ACCORDING TO SUPERSONIC LINEARIZED THEORY

R. S. Bartlett London HMSO 1967 57 p refs Supersedes RAE-TR-66177; ARC-28453 See X67-13108

(ARC-CP-961; RAE-TR-66177; ARC-28453)

The linearized theory of supersonic flow past thin wings is used to obtain expressions for the three components of velocity of the flow about a family of non-lifting, symmetrical delta wings having rhombic cross sections and subsonic leading edges. A Mercury Autocode program has been written for their evaluation and results have been obtained for a particular wing for three Mach numbers and two values of the ratio of semi-span to center line chord. Curves of constant velocity, in planes normal to the free stream direction at and behind the trailing edge, are given for each velocity component. Author

N68-13166# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT THE INFLUENCE OF THE CLEARANCE BETWEEN THE WORKING BLADES AND HOUSING OF A RADIAL TURBINE ON ITS EXPONENT [O VLIYANII ZAZORA MEZHDU RAVOCHIMI LOPATKAMI I KORPUSOM RADIAL'NOY TURBINY NA YEYE POKAZATELI]

Ye. P. Krylov and Ya. A. Spunde 9 Jun. 1967 19 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 7, 1965 p 66–73

(FTD-MT-67-15; AD-661888)

The results of a 1959 experimental study of dissipation in an air radial turbine are reported. The relative internal turbine efficiency was determined: Re number variation was (1.1 - 1.7) x 1,000,000; turbine pressure drop, 1.25 and 1.67; gap variation, 0.15 - 7 mm. It is found that the gap (clearance) loss plays an important role in the axial part of the rotor, and only a very little role in the radial part. The gap swirl results in a gap-to-channel gas flow, and this phenomenon reduces the gas leakage around the rotor-blade tips. The above phenomenon is also enhanced by Coriolis forces. In subsequent testing of various radial turbines, it was noticed that the turbine efficiency depended only very slightly on the gap value. It is found that: (1) The gap loss is considerably lower in radial centripetal turbines than in axial turbines; hence, the gaps in radial turbines need not be very small; (2) An empirical formula has been developed for calculating the gap loss; (3) A gas-dynamic scheme is suggested to explain the low gap loss. TAB

N68-13175 Royal Aircraft Establishment, Farnborough (England).

A MARCHING PROCEDURE FOR THE DETERMINATION OF INVISCID TWO-DIMENSIONAL SONIC FLOW PAST A BLUNT SYMMETRICAL BODY

D. G. Randall Nov. 1966 30 p refs

(RAE-TR-66371)

The equations of motion for two-dimensional, inviscid, sonic flow are written in a form that permits the introduction of a marching procedure for determining the flow past a symmetrical, blunt body. The independent variables are transformed to new variables, θ and s, such that points infinitely far from the body are mapped into the line $\theta = 0$, the line of symmetry is mapped into the line $s = 0$, and the body contour is mapped into the line $\theta = 1$; marching takes place in the s direction, starting from the line $s = 0$. The dependent variables are also transformed, in such a way that the physical quantities have the correct asymptotic behaviour far from the body. Author

N68-13282# New York Univ., N. Y. School of Engineering and Science.

SHOCK GENERATORS IN THE HYPERSONIC TURBULENT BOUNDARY LAYER Technical Report, Jan. 1966–Jun. 1967

Richard Gorman Wright-Patterson AFB, Ohio ARL Sep. 1967 149 p refs

(Contract AF 33(615)-3236)

(NYU-AA-67-106; ARL-67-0186; AD-661992)

In order to reduce the heat transfer and skin friction in a turbulent supersonic boundary layer, a totally immersed shock generator is employed. Values of wall heat transfer, skin friction, shock generator heat transfer and drag, and profiles of flow quantities downstream are obtained experimentally for several configurations. The boundary layer returns to a similar but thicker boundary layer within 20 boundary layer thicknesses downstream of the shock generator. Heat transfer and skin friction reductions of 8% to 27% are obtained. Author (TAB)

N68-13284# Aeronautical Research Council (Gt. Brit.)
A DISCUSSION OF TWO-DIMENSIONAL TURBULENT BASE FLOWS
J. F. Nash London HMSO 1967 48 p refs Supersedes NPL-AERO-1162; ARC-27175 See X66-13426
(ARC-R&M-3468; NPL-AERO-1162; ARC-27175) HMSO: £1 1s

A review of recent experimental and theoretical research on two-dimensional base flows is presented. The main object is to illustrate the extent to which the basic properties of the flow are understood in each of the different flow regimes: subsonic periodic, subsonic nonperiodic, and supersonic. Conclusions from this study show that further work is needed throughout the whole field, but attention is drawn to those areas where the need is most urgent. Author

N68-13322# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BOUNDARY LAYER REACTION WITH A HYPERSONIC STREAM IN A CONICAL NOZZLE [VZAIMODEYSTVIYE POGRANICHNOGO SLOYA S GIPERZVUKOVYM POTOKOM V KONICHESKOM SOPLE]
V. P. Agafonov *In its* Acad. of Sci. of the USSR News Mech. 18 Apr. 1967 p 9–15 refs (See N68-13320 04-23)

It is shown that by use of integral relationships for the continuity equation, a closed system of equations may be obtained and the problem of supersonic flow in a conical nozzle can be solved with allowance for flow core–boundary layer interaction. Plots of the radial and axial M number and pressure profiles showed that growth of the boundary layer may not only lead to a considerable reduction in the size of the flow core, but also cause considerable variations in all gas-dynamic parameters in the direction normal to the flow. Author

N68-13333 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUPERSONIC FLOW ABOUT BLUNT BODIES OF ROTATION [SVERKHZVUKOVOYE OBTEKANIYE ZATUPLENNYKH TEL VRASHCHENIYA]
A. S. Mikheev *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 129–137 refs (See N68-13323 04-19)

Supersonic flow of an adiabatic gas around a blunt body of revolution with a sharp corner is considered. The analysis is a continuation of the method of integral relations proposed by Academician A. A. Dorodnitsyn, but a different method is employed for finding an approximating system of common differential equations, thus lowering their number. A solution is given for a system of curvilinear coordinates and supersonic flow. The thermodynamic properties of the gas are considered known. The equations are integrated, considering the case when there are no intermediate lines between the shock wave and body surface. Author

N68-13334 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF UNSTEADY MOTION OF A WING WITH A SMALL ASPECT RATIO [NESTATSIONARNAYA TEORIYA KRYLA MALOGO UDLINENIYA]
A. N. Kholodilin *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 139–147 refs (See N68-13323 04-19)

The paper develops Prof. N. N. Polyakhov's theory of the unsteady motion of a thin symmetrical wing with a low aspect ratio. Formulas are derived for finding the lifting force which gives the same results as (approved) experimental and theoretical data. The formulas for lift of a finite span wing in steady and unsteady motion are derived by a method somewhat different from that of Polyakov. The differences between the slopes of the lift curves for cases of steady and unsteady motion increase as the aspect ratio of the airfoil decreases. Author

N68-13347
TESTING OF DOWNSTREAM DIFFUSION ON A DUCTED PROPELLER [CONTROLE DE DIFFUSION AVAL SUR HELICE CARENEE]
M. Lazareff [1967] 14 p In FRENCH; ENGLISH summary

The development of diffusion on the downstream jet of a ducted propeller operating at a speed close to hovering is summarized. The diffusion of the jet facilitates the adaptation of the fairing inlet in transition flight. The adverse effect of diffusion in rapid translation is displayed with the simultaneous presentation of a certain amount of jet convergence for this flight regime. The ducted propeller can only be used to its full advantage if it is fitted with a downstream diffusion highly adjustable in flight. Author

N68-13376# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
THE EFFECT OF A FREE SURFACE ON THE TWO-DIMENSIONAL FLOW OF AN INVISCID DENSITY-STRATIFIED LIQUID PAST A SLENDER BODY
E. W. Graham and B. B. Graham Oct. 1967 25 p refs
(D1-82-0664; Rept.-121)

The linearized equation governing the flow of a density-stratified liquid is used, small velocity perturbations and an exponential variation of density with height having been assumed. A dipole in channel flow with a free surface is considered. A streamwise distribution of dipoles would produce a two-dimensional body whose thickness is everywhere proportional to the local dipole strength. The lift of the body would be everywhere zero, and the body would generally be unsymmetrical top to bottom. A vortex in channel flow with a free surface also is considered, and expressions for the perturbation stream function and the wave drag are given. The use of image methods in studying free surface problems is discussed. Author

N68-13417 Giravions Dorand Co., Paris (France).
CONTROL, BY BLOWING, OF BOUNDARY LAYER AND OF CIRCULATION, APPLIED TO FLAP OF TRAILING EDGE OF WING OF ROTOR BLADE [CONTROLE, PAR SOUFFLAGE, DE LA COUCHE LIMITE ET DE LA CIRCULATION, APPLIQUE A DES VOLETS DE BORD DE FUITE D'EXTREMITE DE PALES ROTATIVES]
Rene Dorand [1967] 32 p refs In FRENCH; ENGLISH summary
CFSTI: $3.00

The purpose in view is to determine the suitable relative depth of the flap as a function of the amount of power delivered to the rotor by the blowing slit, in order to be able to perform the following maneuvers correctly: vertical recovery by overall downward

deflection of the flaps, transition to autorotation by overall upward deflection of the flaps, lateral and longitudinal control during engine testing and in forward flight, by cyclic flap deflection. Three cases are considered: (1) The overall power is converted into the jet (jet rotor) where the blowing controls the circulating. (2) A moderate part of the power is converted into the jet. The rotor is mechanically driven and blowing improves the rotor performance. (3) In autorotation without power (natural blowing with boundary layer control) the hollow blades act as a centrifugal compressor. Author

N68-13442# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UNCALCULATED OPERATING REGIMES OF SUPERSONIC DIFFUSER
B. S. Vinogradov 5 Sep. 1967 26 p refs Transl. into ENGLISH from Aviats. Inst. Kazan. Tr. (USSR), No. 76, 1963 p 3–26
(FTD-MT-65-472; AD-661425)

Contents: Peculiarities of flow calculated regime; Basic calculation formulas; Unrated conditions during change of counterpressure; Unrated conditions during change of reduced velocity of incident flow, Characteristics of diffuser. TAB

N68-13458 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
ON THE DORODNICYN METHOD AND SOME MODIFICATIONS FOR THE COMPUTATION OF THE FLOW AROUND BLUNT BODIES [UEBER DAS DORODNICYN-VERFAHREN UND EINIGE MODIFIKATIONEN ZUR BERECHNUNG DER STROEMUNG UM STUMPFE KOERPER]
G. Niehus and E. Plaetschke May 1967 66 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-34)

The paper deals with investigations on the determination of the flow around blunt bodies with given shape in the overcritical free stream. For a solution of this direct problem, two different methods have become known by literature: (a) the Dorodnicyn-method for the steady flow, (b) certain methods of finite differences for the final state of a transient solution of an unsteady swelling flow. In the present paper, different modifications of the Dorodnicyn method are discussed. The required relations are established, the different procedures are indicated, and the practicability of the methods is explained for the example of the circular cylinder. Author

N68-13460# Aerodynamische Versuchsanstalt, Gottingen (West Germany).
A METHOD FOR AUTOMATICALLY MEASURING AND RECORDING INSTATIONARY AIRLOAD DISTRIBUTIONS [EIN VERFAHREN ZUR MESSUNG UND AUTOMATISCHEN REGISTRIERUNG INSTATIONAERER DRUCKVERTEILUNGEN]
H. Hertrich and J. Wagener Jun. 1967 30 p refs In GERMAN, ENGLISH summary
(DLR-FB-67-54) CFSTI: $3.00

A method and a test setup are described, by which a lot of pressure distributions on harmonically oscillating rigid wings have been measured in low subsonic flow. The local instationary airloads at the model surface are transmitted by pressure leads to one central pressure transducer mounted outside the model. The dynamic response of all leads is identical. The process of measurement and the recording of data are automatically controlled by a special electronic measuring system. Two examples demonstrate the usefulness of the method. Author

N68-13500 Royal Aircraft Establishment, Farnborough (England).
COMPUTATION OF THE ONE-DIMENSIONAL UNSTEADY FLOW OF GAS IN A PRESSURE EXCHANGER
B. A. M. Piggott May 1967 26 p refs
(RAE-TR-67123)

A simple mathematical model for the flow of gas in and out of the cells of a pressure exchanger is described. Details of the numerical solution of the resulting non-linear partial differential equations by Hartree's method are given, with particular reference to the treatment of the boundary conditions. The work is illustrated by numerical examples. Author

N68-13511 Aircraft Research Association, Ltd., Bedford (England).
SOME MEASUREMENTS OF THE INTERFERENCE OF A STING SUPPORT ON THE PRESSURE DISTRIBUTION ON A REAR FUSELAGE AND TAILPLANE AT SUBSONIC SPEEDS
E. C. Carter 31 Oct. 1967 27 p ref Presented at the 28th Meeting of the Supersonic Tunnel Assoc., Martin Corp., Denver, 30–31 Oct. 1967 *Its* Wind Tunnel Note No. 67

This note illustrates the way in which the presence of a parallel sting in the rear of a model is likely to change the pressure distribution on the tailplane and fuselage. It is shown that the major influence is on the lower surface of the tail and that the interference can give incorrect values of tail-on C_{m_o}, tail power, and at higher Mach numbers $\delta C_m/\delta C_L$. The interference on the fuselage is shown to be very small if account is taken of the missing areas of fuselage. The interference of the twin strings is also shown to be very small, affecting only the upper surface of the tail with no influence at all on the fuselage. These results not only quantitatively confirm previous measurements made on twin strings with a rear fuselage balance but also show the errors which can occur in single string results and the need for supplementary twin string tests. It is also shown that if drag is of major importance the fuselage split position for twin sting balance tests should be chosen bearing in mind the circumferential pressure distribution in the region. It is desirable to seal the gap if possible to eliminate cross flow. Author

N68-13550# Aeronautical Research Council (Gt. Brit.)
HEAT-TRANSFER AND PRESSURE MEASUREMENTS ON THE UPPER SURFACE OF A DELTA WING AT INCIDENCE AT MACH NUMBERS BETWEEN 2.0 AND 3.6
J. B. W. Edwards London HMSO 1967 39 p refs Supersedes RAE-TR-65144; ARC-27235 See X68-10968
(ARC-R&M-3469; RAE-TR-65144; ARC-27235) HMSO: 17s 6d

Measurements of the distribution of heat-transfer coefficient and static pressure have been made in free flight on the flat upper surface of a sharp-edged delta wing of aspect ratio 1 (76 deg leading-edge sweepback) at 14 deg incidence. Two configurations were tested differing only in edge angle between upper and lower surfaces, being 26.5 deg and 90 deg respectively. From the pressure measurements and some preliminary wind-tunnel tests, it was seen that both exhibited vortical separation at the leading edges with reattachment along the centerline. The heat-transfer coefficient distributions however showed marked differences, particularly in the neighbourhood of reattachment, but for both models were everywhere less than the theoretical values for a flat-plate, based on free-stream conditions. Author

N68-13582# Raytheon Co., Bedford, Mass. Missile Systems Div.
EMPIRICAL DETERMINATION OF DRAG
R. F. Filbin *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 1–39 (See N68-13581 04-31)

Described is a method for determining the drag of a ballistic vehicle on the basis of its position history and without prior knowledge of its velocity and acceleration. The procedure utilizes

position measurement, the flight test data most frequently and most accurately obtained at the missile range, and permits determination of velocity histories to a greater accuracy than is presently obtained by either direct measurement or numerical differentiation of position data. Simultaneously, the procedure provides highly accurate records of vehicle acceleration and drag. S.C.W.

N68-13632# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
EFFECTS OF SEPARATION ON THE CHARACTERISTICS OF AERODYNAMIC CONTROLS ON A REPRESENTATIVE HYPERSONIC CONFIGURATION AT MACH 8
L. Meckler Dec. 1967 94 p refs
(RE-312)

The aerodynamic characteristics of elevons and a deflectable apex on a clipped delta wing configuration are analyzed using Mach 8 experimental data. Longitudinal characteristics and incremental force data are presented for an angle of attack range from -5° to $+54^\circ$, for symmetric elevon deflection angles from -39° to $+39^\circ$, and also for apex deflection angles from 0° to $+20^\circ$. In addition, the longitudinal, lateral, and directional characteristics of the elevons for various asymmetric deflection modes are presented for an angle of attack range from 0° to $+27^\circ$. Control loads and centers of pressure obtained by integrating experimental pressure data are analyzed in conjunction with the incremental force data. The incremental forces induced on the vehicle and the control forces themselves are highly nonlinear and strongly affected by flow separation induced by control deflection. The effects of flow separation, which increases the loads on the wing surface and decreases the loads on the control surface, are evident in the pressure distributions and the pitching moment curves, which show strong reversals at high angles of attack, for various elevon deflection angles. Inviscid flow calculations for the elevon normal loads can be as much as 50% in error because of the first order importance of flow separation effects. Author

N68-13677 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
THEORETICAL STUDY OF FINITE SPAN, WEDGE-PROFILE COMPRESSION RAMP AIR-INTAKES AT SUPERSONIC SPEED [ETUDE THEORIQUE DE PRISES D'AIR A RAMPE DIEDRE, D'ENVERGUE FINIE, EN REGIME SUPERSONIQUE]
Maurice Fenain 1967 46 p refs In FRENCH; ENGLISH summary
(ONERA-TN-117(1967))

The mass flow rate and the additive drag of two types of air-intakes using external compression on a small-angle wedge-profile compression ramp are calculated. In the first case the compression ramp is limited in span by two delta-shaped plates on which the cowl rests. In the second case, the air-intake has no lateral plates. The lateral plates, when they exist, are not necessarily parallel. They may be converging or diverging. Author

N68-13680 Technische Hochschule Munchen (West Germany). Fakultaet fuer Allgemeine Wissenschaften.
"THE THEORY OF SHIP MOVEMENT" BY JOHANN I. BERNOULLI (1667–1748) ["DIE THEORIE DE LA MANOEUVRE DE VAISSEAUX" BEI JOHANN I. BERNOULLI (1667–1748)]
Gerhard K. Lutzeier (Ph.D. Thesis) [1967] 46 p refs In GERMAN

This report gives a brief review on the history of aerodynamic resistance research, and applies the established theories to mathematical analyses of wind effects on sailing vessels. Ship velocity is proportional to the functional angle of sail, ship keel, and the wind profile. Course corrections have to consider the ship's form, resistance of wind and water, pressure point and angle of attack changes, sail surface, etc. Transl. by G.G.

N68-13735 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF AXISYMMETRIC FLOW IN STAGES OF AXIAL-FLOW TURBOGENERATORS
M. I. Zhukovskiy and A. P. Tarabrin *In its* Power Equipment Manuf. 27 Mar. 1967 p 15–26 refs (See N68-13733 04-28)

Calculations of the flow in a long-blade compressor stage are compared with experimental data. The aerodynamic equations are solved by a difference method that modifies other well-known methods as follows: (1) Basic equations are solved, not transformed and reduced to one equation; (2) Central differences are used; (3) Sliding successive approximations are used in solving nonlinear equations by the method of straight lines; (4) It is assumed that the energy loss varies linearly over the z-axis sections; (5) The solution of the constant-flow equation is presented as approximate finite formulas. The axisymmetric flow was calculated for a stage of an experimental axial-flow compressor having $D_{av}/l = 3$, a theoretical pressure of 0.4, and a reaction step at an average radius of 0.5. The estimated results were found to be in fairly good agreement with experimental data for the middle part of the blade. Author

N68-13819# Aeronautical Research Council (Gt. Brit.)
THE LINEARIZED FLOW FIELD OF A RELAXING GAS THROUGH A NON-UNIFORM CHANNEL AND IN A JET AT SUPERSONIC SPEEDS
G. M. Lilley and M. Anne Stevenson London HMSO 1967 49 p refs Supersedes COA-AERO-172; ARC-26140 See N67-13649 (ARC-R&M-3504; COA-AERO-172; ARC-26140) HMSO: £1 1s

A study is made of the linearized differential equation for supersonic flow of a gas relaxing in one mode, assuming a linear rate equation, in a two-dimensional non-uniform channel. An exact solution to this equation is found which includes the corner flow problem as a special case. This solution clearly demonstrates the exponential decay of disturbances along the frozen characteristics associated with the relaxation process. The results obtained for the corner flow problem agree with the earlier results of J. F. Clarke and J. J. Der. Approximate solutions are also obtained which are shown to be adequate for most practical values of the ratio of the equilibrium to the frozen speed of sound. Similar exact and approximate solutions are also found for the linearized case of a two dimensional jet expanding into a uniform pressure field. Author

N68-13842 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE SOLUTION OF A PROBLEM OF DYNAMICS AND DESIGNING OF FLIGHT VEHICLES [K RESHENIYU ODNOY ZADACHI DINAMIKI I PROYEKTIROVANIYA LETATEL'NYKH APPARATOV]
Yu. V. Kozhevnikov *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 1–11 refs (See N68-13841 04-28)

The problem of optimizing the trajectories and basic parameters of aircraft destined for flights in the earth's central gravity field is considered and formulated. It is assumed that an aircraft trajectory begins and terminates in power flight and includes n active sections and some passive actions in between. Equations of aircraft motion on i power flight sections are derived, and the interrelationships of the parameters are established. The proposed procedure makes it possible to determine the optimal parameters of the aircraft, its engines, and the flight program, with their reciprocal effects taken into account. The solution is sought by means of successive approximations in which the most favorable direction of variation of the aircraft's initial characteristics are established at every stage of calculation. The calculation consists of a series of iterative cycles which are effectively performed on a computer. Author

N68-13891 Royal Aircraft Establishment, Farnborough (England).
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 5: APPENDICES
H. R. Hopkin Jun. 1966 87 p refs
(RAE-TR-66200, Pt. 5)

A key is presented as an aid in converting from the old notations for airplanes to the proposed notations. The corresponding symbols denoting the same physical quantity are listed, and the conversion factors required when numerical equivalence is sought are given. Direction cosines between earth axes and body axes are expressed in terms of attitude angles, along with notations for atmospheric motion. Definitions are also given for the relations between higher derivatives of forces and moments and aerodynamic coefficient derivatives, and between attitude and incidence angles in a wind tunnel. Equations of motion are derived for small disturbances of an aircraft with four-fold symmetry from straight steady spinning flight, and for expansions with respect to displacement variables. Symbols are expressed for primary airfoils, flaps, and tabs; for miscellaneous aerodynamic coefficients, and derivatives of forces and moments; and for partial derivatives of functions of velocity and its components. Consideration is also given to matrix notation for vector components, kinematics, and equations of motions. M.G.J.

N68-13895 Royal Aircraft Establishment, Farnborough (England).
A SCHEME OF NOTATION AND NOMENCLATURE FOR AIRCRAFT DYNAMICS AND ASSOCIATED AERODYNAMICS. PART 4: AERODYNAMIC DATA FOR DYNAMICS
H. R. Hopkin Jun. 1966 56 p ref
(RAE-TR-66200, Pt. 4)

Basic definitions and symbols are presented for aerodynamic coefficients and the variables commonly used; the derivatives of forces and moments, and aerodynamic coefficient derivatives; and normalized derivatives of forces and moments. The choice of representative area and representative length is discussed. Also examined are the relations between normalized derivatives of forces and moments, and aerodynamic coefficient derivatives; force and moment derivatives for different systems of axes; aerodynamic coefficient derivatives for body axes and air path axes; and derivatives of forces and moments with respect to different sets of variables. M.G.J.

N68-13904# Aeronautical Research Council (Gt. Brit.).
THE FLOW PRODUCED BY INTERACTION OF A TURBULENT BOUNDARY LAYER WITH A NORMAL SHOCK WAVE OF STRENGTH SUFFICIENT TO CAUSE SEPARATION
J. Seddon London HMSO 1967 35 p refs Supersedes RAE-TM-AERO-667; ARC-22637 See X83-80140
(ARC-R&M-3502; RAE-TM-AERO-667; ARC-22637) HMSO 15s 6d

The nature of normal-shock and turbulent-boundary-layer interaction is described on the basis of an experiment involving two-dimensional flow, at M=1.47, over a flat plate. Special attention is paid to the flow development downstream of separation. Conditions governing reattachment are observed and the nature of the eddy-flow bubble is shown. In the viscous layer itself the flow undergoes successively the three processes of shock compression, displacement, and rehabilitation. For an interaction in which no mainstream constraints are applied, separation occurs at a point two boundary layer thicknesses downstream of the start of interaction and reattachment at 12 thicknesses. Rehabilitation, however, is still incomplete at 50 thicknesses. Velocity profiles are examined in relation to the Coles wake hypothesis. Over the greater part of the flow this hypothesis holds true. It does not hold in the immediate vicinity of the shock wave or in other regions of strong pressure gradient. An empirical extension is suggested to take account of the variations observed. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-12827*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TANKAGE SYSTEMS FOR A METHANE FUELED SUPERSONIC TRANSPORT
Joseph D. Eisenberg and Rene E. Chambellan Washington 1967 16 p refs To be presented at AIAA Meeting on Aircraft Design, Washington, D. C., 12–14 Feb. 1968
(NASA-TM-X-52378) CFSTI: HC $3.00/MF $0.65 CSCL 01C

Although liquid methane fuel promises an economic improvement, its cryogenic nature results in on-board storage problems. A lightweight insulation is required (1) to limit heat influx to the liquid methane, and (2) together with a defrosting system to eliminate external ice formation. The problem remains that, should this fuel be loaded in a saturated condition, as the aircraft climbs and pressure is reduced, much fuel will flash off. Either using pressurized tanks, or subcooling the fuel will solve this problem. With subcooled fuel a pressurizing gas is required. Low solubility gases (e.g., helium, neon) have low availability and may be used only if completely salvaged. Bladders or stand pipes to reduce contact area may be used with soluble gases (e.g., nitrogen) or condensible (e.g., methane gas) pressurizers. Analytical studies indicate that both the pressurized tank and subcooled fuel approaches, separately or in combination, offer potential solutions to the tankage problem. Author

N68-12865 Royal Aircraft Establishment, Farnborough (England).
THE PILOT'S SAFETY PROBLEM IN CATEGORY 2 OPERATIONS AND THE POTENTIAL CONTRIBUTION OF HEAD-UP DISPLAY. INITIAL INVESTIGATION OF HEAD-UP DISPLAY AT B.L.E.U.
J. C. Morrall Jun. 1966 22 p Presented at the Intern. Federation of Airline Pilots Assoc. Symp., Rotterdam, 13–16 Oct. 1965
(RAE-TR-66195)

This report highlights what is believed to be the main safety problem in current bad weather landing and presents results of initial flight trials with a head-up display which show that this aid has great potential value for Category II operations. The safety problem is shown to lie in the limitations of the pilot in controlling the aircraft in pitch, using visual guidance. The head-up display is recommended as a solution to this problem as it can provide an efficient means of combining instrument and visual information. In addition, further improvements could be achieved by optimization of cockpit procedures, whether or not a head-up display is adopted. Author

N68-12879# Speas (R. Dixon) Associates, Manhasset, N. Y.
COST/BENEFIT ANALYSIS FOR ALL-WEATHER LANDING SYSTEMS (AWLS), CATEGORY 2 AND 3 Final Report
R. D. Speas, M. H. Smith, and Harry P. Schmidt Oct. 1967 196 p refs
(Contract FA-67-WA-1642)
(SRDS-RD-67-28) CFSTI: HC $3.00/MF $0.65

This study determines the costs and benefits resulting from implementation of Category 2 and 3 all-weather systems during the 1967–1980 time period, and establishes the optimum practical

ground–airborne implementation schedule, including the priority-ranked order for equipping forty individual airports. The cost benefits, as conservatively quantified in this study, show in general summary terms that: (1) Category 2 has immediate net economic benefits. (2) Category 3a and 3b show nearly the same results and provide net economic benefits if more than twenty-three airports are implemented by 1975. (3) Category 3c will produce net economic benefits only if the majority of the forty airports are implemented by 1980. The total national net cost benefits attributable to the elements quantified by this study range between the following values; the earlier the implementation date and the larger the number of airports equipped the greater the net benefits: Category 2, from +$4 to +$56 million/year. Through Category 3a, from −$24 to +$43 million/year. Through Category 3b, from −$26 to +$61 million/year. Through Category 3c, from −$57 to +$19 million/year. The cost benefits are subject to some variance in their values because of the numerous intangibles which could affect the program and its economics. Author

N68-12897# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Section.

A STUDY OF WINDSHIELD TEMPERATURES IN FLIGHT ON THE RCAF YUKON AIRCRAFT

D. J. Peake and N. J. Della Valle (Central Exptl. and Proving Estab., Ottawa) Aug. 1967 37 p refs
(LR-489; NRC-9824)

The measurement of temperatures on the glass surfaces, in the vinyl interlayer and at a mounting bolt, of a windshield panel on an Yukon aircraft was undertaken during two transatlantic flights. The object was to determine the effectiveness of the electrical heating in the panel, in maintaining the strength of the vinyl interlayer at a temperature sufficient to resist collision with birds, particularly during the climb and descent phases of flight, and to assess the temperature difference between the panel and its frame. A cycled heat input of 0–2.2 watts/in^2 maintains adequate panel resistance against 4-lb. bird impacts at 170–200 knots IAS (climb speeds). At 250–270 knots IAS during the initial portion of the descent, the heating is, perhaps, marginal. During climb and descent, an average temperature difference between the vinyl and a mounting bolt was 8–9°C. Author

N68-12964*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TECHNOLOGICAL GAPS IN V/STOL DEVELOPMENT

Richard E. Kuhn 1967 64 p refs Presented at the Univ. of Tenn. Space Inst., Tullahoma, Tenn., 25 Sep.–6 Oct., 1967
(NASA-TM-X-60770) CFSTI: HC$3.00/MF$0.65 CSCL 01C

Areas in V/STOL technology requiring further attention are examined. There are many areas where additional work will lead to performance improvements and enhance reliability. In some cases, such as the stopped rotor and tilt rotor, additional work, including flight demonstrations, will be required before a full assessment of the problems of the type can be made. It is indicated that the primary need is that of identifying the mission for which V/STOL aircraft should be designed. In this regard, work on the noise and traffic control and instrument flight problems appear most important because minimization of such problems will greatly affect any assessment of the missions for which V/STOL aircraft should be designed. Author

N68-12970 Aeronautical Research Council (Gt. Brit.)

FREE-FLIGHT MEASUREMENTS OF THE INCREMENTAL DRAG DUE TO ENGINE NACELLES ON A TRANSONIC SWEPT-WING AIRCRAFT

G. K. Hunt London HMSO 1967 46 p refs Supersedes RAE-TR-66181; ARC-28388 See X67-10890
(ARC-CP-960; RAE-TR-66181; ARC-28388) HMSO: 9s

Models of a swept wing aircraft, without nacelles and with a pair of simple nacelles attached in three different ways, were flown at transonic and low supersonic speeds at Reynolds numbers up to 10 million. From measurements of their zero-lift drag the incremental drag caused by each nacelle installation was determined. A breakdown of the incremental drag shows that, at the design Mach number of 1.2, the external drag caused by a pair of pylon-mounted nacelles on the wing or on the body was about twice that caused by a pair of nacelles attached directly to the wing. Author

N68-12991 Royal Aircraft Establishment, Farnborough (England).

LOW-SPEED WIND-TUNNEL TESTS ON A 1/6TH SCALE MODEL OF AN AIR-CUSHION-VEHICLE (BRITTEN-NORMAN CUSHIONCRAFT C.C.2)

W. J. G. Trebble Dec. 1966 62 p refs
(RAE-TR-66383)

The effects of mainstream speed on the performance and stability of a model of an air cushion vehicle were investigated. At constant speed of the lifting fan, the lift increases both with reduction in ground clearance and increase in forward speed. The craft has a large drag which is mainly intake momentum drag. Limited speed could be available from tilting the craft bows down, but augmentation from propulsive units would be required for higher speeds. Large nose-up moments occur at forward speed, reaching a maximum when the mainstream dynamic head is comparable with the cushion pressure. At higher speeds, the front air curtain breaks down with a resultant rearward movement of the centre of cushion lift thus giving some reduction in the nose-up moment. Pitch stiffness is reduced to zero when the front curtain breaks down; at higher speeds there is some recovery in stability. Attempts to improve pitch control by means of a tailplane or by throttling the front jet proved inadequate. Author

N68-13000 Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

INTERACTION BETWEEN AIRFRAME POWERPLANT INTEGRATION AND HOT GAS INGESTION FOR JET-LIFT V/STOL TRANSPORT AIRCRAFT

U. Gittner, F. Hoffert, and M. Lotz 1967 37 p refs Presented at the 31st AGARD Flight Mech. Panel Meeting on Integration of Propulsion System in Airframe, Gottingen (W. Germany), 13–15 Sep. 1967

This paper concentrates on the interaction between airframe-powerplant integration and hot gas reingestion. To predict the hot gas reingestion effects for the experimental V/STOL aircraft Do 31 corresponding model tests have been carried out. The important results have been confirmed by full-scale tests with the large hovering rig. The intake temperature rise is governed by hot gas fountains caused by opposing jet flows, meeting on the ground. The hot gas fountains are of considerable influence on the propulsion engines, but scarcely affecting the high positioned lift engine intakes. Hot gas ingestion by buoyancy effects is of minor importance. Model tests for a proposed operational jet lift transport have shown considerably higher temperature rises at the propulsion engine intakes. However, these unfavourable results can be overcome by fairly small changes of the propulsion engine positioning. It is concluded that operational jet lift V/STOL transport aircraft, especially of the first generation, should take advantage from a less integrated powerplant system, permitting configuration modifications without major structural changes, even in an advanced stage of development, thereby reducing the development risk. Author

N68-13018 National Gas Turbine Establishment, Pyestock (England).

VTOL AIRCRAFT NOISE

T. J. Hargest 1967 21 p refs Presented at the AGARD Specialists' Meeting on Fluid Dyn. of Rotor and Fan Supported Aircraft at Subsonic Speeds, Gottingen (W. Germany), 11–13 Sep. 1967

The noise level of VTOL aircraft is discussed in terms of the size and power of various lifting systems. It is assumed that noise reduction and/or suppression will be required for central city terminal operation of these aircraft, and mention is made of the difficulties in defining internationally acceptable perceived noise levels. Engine noise is considered as a function of power requirements and design trends are examined. Noise problems in buried low velocity fan installations and exposed rotor systems are compared, and it is concluded that existing flight-tested lifting systems seem incapable of developing the high noise standards needed for city center terminal operations. However, the application of circulation controlled rotor concepts to the various lifting systems may reduce aircraft noise to an acceptable level. E.J.S.

N68-13036 Carleton Univ., Ottawa (Ontario).
ANALYTIC DETERMINATION OF THE AXIAL VELOCITY THROUGH A PROPELLER MOVING PERPENDICULAR TO ITS AXIS
P. Mandl [1965] 28 p refs

A theory is developed for predicting the inflow through a propeller with finite blade number, moving at right angles to its axis. The mathematical model employed for the wake is that of a system of spiral surfaces, generated by skewed helices descending below the propeller disk at a prescribed rate. The strength of these helical vortices varies both with radius and blade azimuth. Based upon a combination of lifting-line, lifting-surface concepts and the use of oblique curvilinear coordinates to describe the instantaneous shape of the spiral wake, a fundamental integral equation is derived relating the radially and time-varying downwash field to the radially and time-varying circulation distribution along the blades. By postulating harmonic blade loading, explicit expressions are obtained for the variation of the inflow with both blade azimuth and blade span for any value of the advance ratio. By restricting the scope of the theory to the case of small advance ratios, the time-dependent, three-dimensional flow can be calculated as a small perturbation of the steady, axially symmetrical flow. The relevant formulae for the radial distribution of the harmonics of the downwash simplify, because the total induced effect of the spiral wake can be expressed in closed form. Author

N68-13037 Lockheed-California Co., Burbank.
ANALYSIS OF STOWED ROTOR AERODYNAMIC/AEROELASTIC CHARACTERISTICS
Robert E. Donham [1967] 39 p

Methods have been developed for determining the airload distribution on the blade of the rotor during inflight transition from the fixed wing to the compound helicopter mode and from the compound helicopter to the fixed wing mode. The transient responses of the rotor during transition have been examined using time history methods. A method using subsonic kernel function techniques has been used in determining the stiffness required of the blade to prevent aeroelastic divergence. The viscous cross flow is determined and superimposed on the potential effect. The applicability of the methods of analysis outlined is substantiated by correlations with specific results obtained in full scale experimental investigations of a 33-foot diameter three-blade rotor in the 40×80' wind tunnel at NASA Ames. The comparisons show generally good agreement between the calculated and measured results. Author

N68-13064 Royal Aircraft Establishment, Farnborough (England).
ON HYPERSONIC CRUISING AIRCRAFT WHICH CAN HAVE ALL LEADING EDGES SWEPT. PART 1: DESIGN OF AIR INTAKES
L. H. Townend Feb. 1967 38 p refs
(RAE-TR-67046, Pt. 1)

An assessment is made of hypersonic intakes which, at design conditions, should produce two-dimensional compression, and may have all or most of their leading edges swept. Unswept edges occur only on bodies which may be used for (and so cooled by) fuel injection into the center of the intake flow. Optimized three-shock intakes are shown to be geometrically and propulsively less attractive than those producing partly isentropic compression; for the latter, considerations of boundary layer separation are shown to restrict design flexibility. Other constraints are shown to arise if a particular application is envisaged. Author

N68-13085 Royal Aircraft Establishment, Farnborough (England).
THE CAPABILITY OF HIGH SPEED TRANSPORT AIRCRAFT TO AVOID AREAS OF ADVERSE WEATHER
W. J. G. Pinsker Jun. 1967 30 p
(RAE-TR-67133)

Two fundamental techniques are discussed: maneuvers designed to avoid hazardous weather, and slow-down maneuvers to enter the weather hazard at an acceptable speed. Data are given which permit the formulation of requirements for weather radar performance to permit the pilot timely and effective evasive action. Author

N68-13087 Royal Aircraft Establishment, Farnborough (England).
INVESTIGATION INTO A FUEL TANK EXPLOSION: BRITANNIA G-ARKA
M. E. Rogers and H. W. G. Wyeth Apr. 1967 17 p refs
(RAE-TR-67080)

An investigation was made of a Britannia fuel tank explosion from which it was concluded that mist or foam generated by refueling must have been ignited by an electrostatic discharge within the tank ullage. Recommendations directed towards the prevention of similar incidences are made. Author

N68-13103# Interior Dept., Washington, D. C. Div. of Wild Life Research.
CONTROL OF BIRDS ON AND AROUND AIRPORTS Interim Report, 1 Jul. 1965–30 Jun. 1966
John L. Seubert Jun. 1967 22 p
(Contract FA-65-WAI-77)
(SRDS-RD-67-52) CFSTI: HC $3.00/MF $0.65

The majority of bird strikes continue to occur during takeoffs and landings; engines, windshields, and wings still receive most of the strikes and damage; and gulls and waterfowl continue to be the main hazards. The contractor's recommendations for alleviating bird hazards at John F. Kennedy International Airport are submitted. Breeding gull populations continue to increase in the Northeast States, where little progress has been made in reducing the amount of human food wastes available to gulls. Birds migrating at night in the fall in the Mississippi Valley fly at low altitude, between 450 and 1,500 feet above the ground. The collection and analysis of data in a study of the similarities and differences between sounds of Electra engines and crickets was completed. Author

N68-13119 Aerodynamische Versuchsanstalt, Gottingen (West Germany).
JET INTERFERENCE MEASUREMENTS ON A VTOL-MODEL WITH JET SIMULATION BY FANS
H. Fuetterer and L. Harms [1966] 31 p refs

The technical performance of wind-tunnel tests on VTOL-models with fan-lift engines as well as the characteristics of

these fan engines are described. The influence of the fan efflux flow on the lift and pitching moment of the fuselage, wing and tailplane is determined from three-component measurements in the low speed wind-tunnel of the AVA. Author

N68-13122# Federal Aviation Agency, Washington, D. C. Dept. of Transportation.
THE SUPERSONIC TRANSPORT: THE SONIC BOOM AND YOU
John O. Powers and Kenneth Power [1967] 40 p
(AD-661840)

An attempt was made to outline the historical development of the United States supersonic transport development program and to place in proper perspective the national significance of the SST program. The technological aspects and problems of the sonic boom were reviewed. The actual overflight sonic boom programs to date were reviewed and capsule results were discussed. Author (TAB)

N68-13125# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
DIGITAL COMPUTER SOLUTION OF AIRCRAFT LONGITUDINAL AND LATERAL-DIRECTIONAL DYNAMIC CHARACTERISTICS
John M. Griffin Dec. 1966 106 p refs
(SEG-TR-66-52; AD-661596)

Two Fortran IV computer programs are presented for the solution of aircraft longitudinal and lateral-directional transfer function factors and dynamic characteristics. The longitudinal program solves for the three-degree-of-freedom dynamic characteristics, numerator factors, and transfer functions. The lateral-directional program solves for three-degree-of-freedom characteristics, some numerator factors and transfer functions. In addition, where possible, specialized handling qualities parameters are computed and printed out. The equations and their underlying assumptions are discussed. The two complete computer programs are shown, and the input, output, and program functions are discussed. Author (TAB)

N68-13136 Royal Aircraft Establishment, Farnborough (England).
DEVELOPMENT OF IMPROVED FANS FOR THE BRITTEN NORMAN CC2-001 CUSHIONCRAFT
P. Brotherhood Aug. 1966 103 p refs
(RAE-TR-66271)

The original fans installed in the CC2-001 were unsatisfactory because they had low static and total efficiencies and were also working "off-peak". One third scale tests have been made on various fan designs and substantial improvements in performance have been demonstrated. The results of the tests are given in the form of characteristic curves together with velocity and pressure distributions at the fan outlet. Fans of improved design have now been installed in the modified CC2-001. Tests with various types of diffuser have also been made and reported. Author

N68-13139 Royal Aircraft Establishment, Farnborough (England).
A NOTE ON SOME STATIC TESTS OF FLEXIBLE SKIRTS FOR HOVERCRAFT
W. G. S. Lester and F. T. Kiernan Feb. 1966 38 p ref
(RAE-TR-66053)

A series of static tests conducted to establish an efficient form of flexible skirt for a peripheral jet type of hovercraft is reported. The importance of designing the peripheral jet system in conjunction with the skirt is demonstrated. The results suggest that the effective width of a flexible nozzle is less than its actual width and the discharge coefficient requires determining experimentally for each configuration. It is concluded that skirt configuration performance is best compared on the basis of power input to a skirt to generate a given cushion pressure for a specified daylight clearance. The results confirm that the skirt input power per unit exit area, based on daylight clearance and jet length, is directly proportional to (cushion pressure)$^{3/2}$. Author

N68-13144
ROTOR AERODYNAMICS RETROSPECT AND PROSPECT, PART 2
J. P. Jones [1967] 12 p

A discussion is presented on the theory of rotor aerodynamics. The historical development is mentioned, and the problem areas in understanding the aerodynamics are emphasized. Analyses of the open rotor are described, and the results are discussed. It is determined that the classical technique of testing models in wind tunnels has only limited application and that building the final solution by linear combination of solutions to smaller parts is not valid. The importance of engine design for the rotorcraft design is indicated. N.E.N.

N68-13145 Lockheed-California Co., Burbank. Rotary Wing New Design Div.
MEASUREMENTS AND ANALYSES OF HELICOPTER ROTOR LOADS IN HIGH SPEED FORWARD FLIGHT, PART 1. DYNAMICS OF ROTORS OPERATING AT HIGH ADVANCE RATIOS, PART 2
J. Sweers and G. J. Sissingh [1967] 23 p refs

Flight tests were made with a compound helicopter to obtain measurements of air pressures, blade stresses, blade control angles, and flight attitude to determine the factors contributing to oscillatory blade loads. Experimental and theoretical data are compared for selected conditions covering a range of flight speed from 51 to 232 knots. It was determined that at low speed the wake vorticity is a major contributing factor, and that at higher forward speeds the effect of blade torsional response becomes of primary importance. The effect of compressibility on airloads, data on the strength of the trailing tip vortex, and the comparison between uniform inflow theory and ring vortex theory are illustrated in graph form. N.E.N.

N68-13148* National Aeronautics and Space Administration, Washington, D. C.
FIFTY YEARS OF AERONAUTICAL RESEARCH
1967 76 p
(NASA-EP-45) CFSTI: $3.00 CSCL 01C

The formation of the National Advisory Committee for Aeronautics (NACA) in 1915 is discussed in relation to its role in closing the dangerous gap then existing between the state of aeronautical technology in Europe and in the United States. The history of Langley Field is traced from its inception in 1917, and the technological advances which resulted from its research laboratory and test facilities are described for each decade. The creation of NASA in 1958, using the NACA staff and laboratories as a nucleus, is discussed, and the developments and contributions of the Langley Research Center to the various space programs and to aeronautical research are detailed. M.G.J.

N68-13150 Boeing Co., Morton, Pa. Vertol Div.
INFLUENCE OF THE TIP VORTEX ON HELICOPTER ROTOR NOISE
H. Sternfeld, Jr. [1966] 22 p refs

The acoustical signature of a helicopter lifting rotor is highly complex due to the number of various noise producing mechanisms which act simultaneously. One phenomenon, however, rises above all others and virtually sets the external noise level of the aircraft. This condition, known as blade bang or blade slap, arises from the

intersection of a rotor blade with the tip vortex shed by a preceding blade in the rotor system. The differences are discussed between banging and non banging signatures and the conditions which result in blade vortex intersections. Correlation between acoustical signature and the analytical prediction of vortex interaction is shown. Experimental investigations utilizing smoke vizualization techniques are reported and illustrated with photographic sequences from motion pictures, showing the formation of the vortex core structure on a rotor test tower, and the intersection of rotor blades and tip vortices on a tandem rotor helicopter. Author

N68-13168# National Research Council of Canada, Ottawa (Ontario).
SOME ADDITIONAL LOW SPEED BIRD IMPACT TESTS ON A MODIFIED WINDSHIELD OF THE CL-41 TUTOR AIRCRAFT
D. J. Peake (Natl. Aeron. Estab.) Aug. 1967 42 p refs
(NRC-9796; LR-488)

The resistance to bird impact of a modified windshield of the RCAF CL-41 Tutor aircraft was investigated utilising the high speed rocket sled. The modifications included the installation of a vinyl splinter shield bonded to the main glass inner layer. This unheated windshield was shown to be incapable of withstanding a 3.5-lb. bird impact at 259 knots TAS at a temperature of about 40°F, but was resistant to penetration at a temperature of about 70°F. Author

N68-13171 Westland Helicopters, Ltd., Yeovil (England).
A GENERAL SURVEY LECTURE, PART 2
Quo Vadimus and R. Hafner Aug. 1967 42 p refs Presented at the AGARD Specialists' Meeting, Gottingen (W. Germany), 11–13 Sep. 1967
(TD/(R)/EW/305)

Against the background of certain basic VTOL concepts a number of well known VTOL configurations are discussed. With the equivalent flat plate area as common yardstick a comparison of aerodynamic performance of these configurations is made. It is shown that for ultra-short range the Pure and the Winged helicopter, although relatively slow, are viable solutions. For longer ranges and higher speeds, up to 500 m.p.h., the Convertible Rotor configuration is shown to be the best. For still higher speeds, the Stowed Rotor appears to be an optimum. However, many other important aspects of these aircraft, such as weight, complexity, vibration, etc. were considered. Author

N68-13176 Royal Aircraft Establishment, Farnborough (England).
THE DYNAMICS OF AIRCRAFT ROTATION AND LIFT OFF AND ITS IMPLICATION FOR TAIL CLEARANCE REQUIREMENTS, ESPECIALLY WITH LARGE AIRCRAFT
W. J. G. Pinsker Mar. 1967 54 p refs
(RAE-TR-67065)

Ground clearance requirements are considered in relation to take off, treating lift off as a dynamic manoeuvre. It is shown that ground clearance is defined by conditions about one to two seconds after lift off. Simple calculations are presented which permit a rational assessment of the proper tail and wing tip clearance margins arising from the immediate post lift off motion of an aircraft. These effects are potentially more severe for the larger aircraft and are aggravated on tailless designs by adverse elevator lift. Recommendations are made for the use of directors and autostabilisation in this context. Author

N68-13206 McDonnell Aircraft Corp., St. Louis, Mo.
POWER EFFECTS ON TWO-FAN-IN-FUSELAGE FIGHTER CONFIGURATION
R. B. Jenny [1967] 21 p

Two powered models of fan-in-fuselage VTOL airplanes have been tested. These models represented a supersonic VTOL fighter configuration with three fans in the fuselage, and a subsonic VTOL fighter configuration with two fans in the fuselage. The fan performance was determined to be quite sensitive to inlet geometry. The effects of ground proximity were found to be quite small. Exit louvers were found to be an effective device for controlling the thrust deflection angle, and the effects of louver area were measured. The interference effects on lift at forward speed were found to be sensitive to the position of the fan relative to the wing, and the interference drag was found to agree quite well with momentum theory. Author

N68-13244 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).
INLET MEASUREMENTS ON A VTOL-AIRCRAFT MODEL
Rudolf Goethert [1967] 27 p refs

For a VTOL-aircraft project with three jet engines installed in the fuselage, wind-tunnel investigations were made to provide the aerodynamic characteristics of the air intakes during the hovering and transition phase. Two engines produce pure jet lift and the third is a combined lift-cruise engine (swivel cascades at jet exits). Results of the lift engines' intake measurements are given. Various intake-flap systems for the jet lift engines were studied which have to cover the bell-mouth inlets during cruise flight and should improve the inlet flow conditions during hovering and transition. Engine windmilling was tested by various scuttles at the outlet of the engine in order to produce the pressure drop between the compressor's inlet plane and the jet outlet plane necessary for restarting. Their effectiveness was tested in the crucial flight regime. Author

N68-13245 Vereingte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
JET INFLUENCE ON V/STOL AIRCRAFT IN THE TRANSITIONAL AND HIGH SPEED FLIGHT REGIME
Guenter Krenz and Juergen Barche [1967] 29 p refs

Results of investigations related to aerodynamic problems of V/STOL aircrafts are summarized. The results are based on wind tunnel tests for a fighter type aircraft in a range from zero forward speed up to sonic velocity. Special attention has been paid in the change of aerodynamic forces and moments during transition and in STO with ground interference. Tests up to transonic speed are discussed. Author

N68-13246 London Univ. (England). Dept. of Aeronautics.
TRANSIENT AERODYNAMIC FORCES ON A TILT-PROPELLER VTOL AIRCRAFT IN HOVERING
A. R. S. Bramwell [1965] 16 p refs

The transient aerodynamic interference between a lifting blade and the wing of a VTOL tilt-rotor configuration was investigated using the interference theory of Bramwell. The results show that the interference forces can be very large, especially when the rotor is close to the wing and the wing chord is large. For a rotor of given thrust the transient loads are inversely proportional to the number of blades. The mean value of these forces is small, however, and not likely seriously to affect the performance, being generally much smaller than the downwash drag load. Author

N68-13247 Vereinigte Flugtechnische Werke G.m.b.H., Bremen (West Germany).
V/STOL WIND TUNNEL TESTING—PAST DEVELOPMENT, EXPERIENCES AND FUTURE DEVELOPMENT
B. Ewald [1966] 25 p refs

The similarity laws relating to simulation of air intakes and jets in wind tunnel and static tests are discussed. A presentation is given of the different known techniques to simulate air intakes and jets. Several wind tunnel programs are presented as examples to demonstrate the advantages and disadvantages of different techniques. Future possibilities in the development of thrust simulation techniques are indicated. The correct simulation of intake flows and jets in wind tunnels not only dictates the testing technique but the capabilities of the associated equipment and the tunnel itself. In extreme circumstances this leads to the design and construction of special VSTOL wind tunnels. The properties required of such tunnels are discussed. Author

N68-13285# Bell Helicopter Co., Fort Worth, Tex.
EVALUATION OF LAMINATED ELASTOMERIC BEARINGS IN THE UH-1 HELICOPTER TAIL ROTOR
Castle H. Fagan Jul. 1967 82 p refs
(Contract DA-44-177-AMC-313(T))
(BHC-572-099-004; USAAVLABS-TR-67-36; AD-661614)

Phase I of the program involved fabrication and bench testing of the bonded-type elastomeric bearings. Bench tests showed that two thrust bearings of this type would be required per grip to carry the blade centrifugal force. An experimental tail rotor assembly utilizing the radial and thrust bearings was designed and fabricated. Whirl and shake tests were conducted to determine rotor natural frequencies, dynamic spring rates, and bearing durability. Phase II of the program consisted of flight testing of the bonded-thin-layer-type bearing tail rotor. During the latter part of the program, molded-type elastomeric thrust and radial bearings were designed and fabricated. Results from both configurations compared favorably with standard UH-1 tail rotor data except for higher Sta. 21.6 blade oscillatory loads. The higher oscillatory loads, which would limit the allowable blade useful life, were attributed to tail rotor natural frequencies occurring near the helicopter operating three-per-rev. resonance. The second configuration is more attractive from a hardware, assembly, and flight operation characteristics standpoint. The molded-type elastomeric bearings were found to be marginally satisfactory for this application. Author (TAB)

N68-13292# Raven Industries, Inc., Sioux Falls, S. Dak. Flight Services Div.
SKYHOOK CHURCHILL 1967 Final Report
Paul S. White 1 Oct. 1967 189
(Contract N00014-67-C-0371)
(R-1667; AD-661337)

Twenty-five launches were attempted of which twenty-three were successful. This report describes individual flights, equipment used, altitude and trajectory information, and recommendations and conclusions for future programs. Author (TAB)

N68-13308 Hawker Siddeley Aviation, Ltd., Hatfield (England).
INITIAL STUDIES OF JET LIFT SYSTEMS WITH FAN-LIKE EXHAUST CHARACTERISTICS FOR V/STOL TRANSPORT AIRCRAFT
T. K. Szlenkier, A. W. Bishop, and A. Hartmann (Dornier-Werke G.m.b.H., Friedrichshafen) [1967] 28 p refs

A free mixing system and another incorporating a simple ejector giving a small thrust augmentation, are proposed. Analytical methods were used to select preferable nozzle arrangements and to predict ejector performance. Cold-air tests were conducted for nozzle assessment, to determine the best ejector setting, and to obtain the efflux dynamic pressure and thrust characteristics. The required pressure reduction was obtained and small thrust gains were demonstrated for the ejector systems. Interpretation of test results indicates that practically all undesirable effects of high velocity and temperature jets can be considerably reduced. Author

N68-13382# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
LATERAL-DIRECTIONAL FLYING QUALITIES FOR POWER APPROACH: INFLUENCE OF DUTCH ROLL FREQUENCY Final Report, Oct. 1966–Sep. 1967
Edward Seckel, James A. Franklin, and George E. Miller Sep. 1967 70 p refs
(Contract Nonr-1858(50); Grant NSF GP-579)
(Rept.-797; AD-661873)

The program was conducted to extend the previous lateral-directional flying qualities research at Princeton University to include the influence of Dutch roll frequency. Simulated carrier approaches were flown in a variable stability Navion airplane at a closure speed of 105 knots. An environment of moderate natural turbulence and the carriers turbulent wake were simulated. All operations were conducted in daylight under visual flight conditions. Data in the form of pilot Cooper ratings and commentary were obtained for configurations having several combinations of Dutch roll frequency, Dutch roll damping, and dihedral effect. Some limited testing was conducted at different roll time constants. The results of the program established a range of Dutch roll frequency and dihedral effect considered to be the most acceptable for the carrier approach task in turbulence. Trends of pilot opinion rating were qualitatively established for departures of frequency and dihedral effect from their optimum levels. The factors contributing to the deterioration of pilot rating in these instances were found to be turbulence sensitivity in roll and yaw, a predominantly yawing Dutch roll mode, and heading control problems. Increased Dutch roll damping was found to improve the pilot rating of those configurations which were sensitive to turbulence in yaw and those which had a predominantly yawing Dutch roll mode. Author (TAB)

N68-13424 Royal Aircraft Establishment, Farnborough (England).
LOW SPEED WIND TUNNEL INVESTIGATION OF THE ROLL STABILITY OF A 1/5 SCALE MODEL OF THE SHORT SC 1 AT LARGE SIDESLIP
W. J. G. Trebble May 1967 36 p ref
(RAE-TR-67104)

In order to facilitate the study of the roll stability of V/STOL aircraft at large angles of sideslip, low speed wind tunnel tests have been made on a 1/5 scale model of the Short SC 1. The results show that very large rolling moments can be produced if roll and sideslip are present together because of the lateral movement of the wing center of pressure. This rolling problem is aggravated by a loss in aileron power as sideslip angle is increased. Recovery is feasible by turning into wind (reducing sideslip) and thus reducing the rolling moment to an acceptable level. Author

N68-13444 Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).
ENGINE AIRFRAME INTEGRATION PROBLEMS PECULIAR TO AIRCRAFT CONFIGURATIONS WITH NACELLES MOUNTED ABOVE THE WING
G. Loebert and J. Thomas [1967] 30 p

In the case of small high-performance low-wing jet aircraft, structural and high-lift considerations favour an engine location above the wing. In this paper the low and high-speed aerodynamical and flight dynamical problems and advantages of this engine location are presented and analysed. Author

N68-13485# Rockefeller Inst., New York.
BAT COLLISIONS WITH HIGH PERFORMANCE AIRCRAFT
Timothy C. Williams and Janet M. Williams Nov. 1967 13 p refs Prepared for Smithsonian Inst.
(Contract F44620-67-C-0063)
(AFOSR-67-2510; AD-661329)

Microscopic examination of animal remains from birdstrikes showed that bats account for at least some of the birdstrikes reported at Randolph Air Force Base, Texas. The distribution of the Mexican Free-tailed bat during the night at ground level seems to be constant in all locations tested in and near the base; concentrations of a second species of bats, probably Myotis velifer occur around strong lights which attract insects. Mexican Free-tailed bats emerging from the Bracken Cave near the base do so in dense clusters of 100-1000 animals; some of these bats fly at least 2000AGL. Some of these bats or clusters of bats are identifiable on MPN 16 Radar, and areas of maximum concentration can be detected. At night in late October the concentration of bats from ground level to 1500 feet averages about one bat/million cubic feet. Above 1500 feet the concentration of birds increases. It is believed that much information regarding the density of flying animals is presently available through radar systems and that this information, if utilized, would be of vital importance to aircraft.
Author (TAB)

N68-13512# Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).
DEVELOPMENT AND TESTING OF HEIGHT HOLDING SYSTEM FOR LOW-FLYING AIRBORNE VEHICLES [SYSTEMENTWICKLUNG UND ERPROBUNG EINER HOEHENHALTUNG FUER TIEFFLIEGENDE FLUGKOERPER]
W. Lincke, H.-J. Seeger, and R. Staufenbiel 1966 30 p In GERMAN Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg (W. Germany), Oct. 1966
(DGRR/WGLR Paper-60-101; EM/30/66) CFSTI: HC $3.00/MF $0.65

The development of a height holder for low-flying airborne vehicles is described in detail, starting with the initial theoretical considerations and continuing through to the analysis of flight trial results. The purpose is to demonstrate that if theory and equipment development are closely integrated—by progressive incorporation of real components in the simulations—it is possible to test every component of a newly-developed system on the ground, thereby considerably reducing the risks inherent in flight testing.
Author (ESRO)

N68-13517*# Boeing Co., Renton, Wash.
STUDY OF AIRCRAFT IN SHORT HAUL TRANSPORTATION SYSTEMS
Washington NASA Jan. 1968 74 p
(Contract NAS2-3862)
(NASA-CR-986) CFSTI: HC $3.00/MF $0.65 CSCL 01C

The intercity operation of advanced short-haul transport aircraft were evaluated in several assumed transportation systems in the 1985 period. Three separate areas of the country, the Northeast, West Coast, and the Gulf Coast–Florida areas, were used in assessing the suitability of aircraft ranging from vertical takeoff and landing, through short takeoff and landing, to conventional takeoff and landing types. The figures of merit considered in comparing the relative suitability of the concepts included direct operating costs versus range, vehicle profitability on a systems wide basis, and the extent and magnitude of the noise generated by each concept. The sensitivity of mission performance to changes in the aircraft characteristics and system operations is determined and key problem areas where additional research may improve the aircraft transportation systems are identified.
R.N.A.

N68-13561*# National Aeronautics and Space Administration, Washington, D. C.
HISTORY OF AVIATION AND COSMONAUTICS, VOLUME 1
N. D. Anoshchenko, ed. Nov. 1967 38 p refs Transl. into ENGLISH from the book "Iz Istorii Aviatsii i Kosmonavtiki, Vyp. 1" Moscow, 1964
(NASA-TT-F-11427) CFSTI: HC $3.00/MF $0.65 CSCL 01B

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5. NEWS ITEMS IN THE SOVIET NATIONAL ASSOCIATION OF HISTORIANS OF NATURAL SCIENCE AND TECHNOLOGY p 32–37

N68-13562*# National Aeronautics and Space Administration, Washington, D. C.
IN MEMORIAM SERGEY GRIGOR'YEVICH KOZLOV
V. A. Popov *In its* Hist. of Aviation and Cosmonautics, Vol. 1 Nov. 1967 p 1–6 (See N68-13561 04-02)

A biographical sketch of Professor Kozlov is presented, and his accomplishments in the field of aviation engineering are cited.
N.E.N.

N68-13563*# National Aeronautics and Space Administration, Washington, D. C.
THE FIRST USSR ROCKET PLANE FLIGHTS
I. A. Merkulov *In its* Hist. of Aviation and Cosmonautics, Vol. 1 Nov. 1967 p 7–9 (See N68-13561 04-02)

A brief history of Russian rocket planes and their flights is presented. The period covered is from the wooden tailless plane of 1932 to the first manned flight with the engine operating, in 1942.
N.E.N.

N68-13564*# National Aeronautics and Space Administration, Washington, D. C.
ON THE 75TH ANNIVERSARY OF THE BIRTH OF THE AIRCRAFT DESIGNER K. A. KALININ
V. B. Shavrov *In its* Hist. of Aviation and Cosmonautics, Vol. 1 Nov. 1967 p 10–15 (See N68-13561 04-02)

The semi-cantilever and cantilever monoplanes designed by Kalinin between 1925 and 1937 are briefly described, and the designer's technical achievements are indicated.
N.E.N.

N68-13574*# International Information, Inc., Philadelphia, Pa.
HISTORY OF AVIATION AND COSMONAUTICS, VOLUME 4
N. D. Anoshchenko, ed. Washington NASA Nov. 1967 51 p refs Transl. into ENGLISH of the book "Iz Istorii Aviatsii i Kosmonavtiki, Vyp. 4" Moscow, Izd. AN SSSR, 1965
(Contract NASw-1499)
(NASA-TT-F-11430) CFSTI: HC $3.00/MF $0.65 CSCL 01B

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1. IN MEMORY OF SERGEY PAVLOVICH KOROLEV B. V. and M. K. p 1–3

2. PRACTICAL SIGNIFICANCE OF THE SCIENTIFIC AND TECHNICAL PROPOSALS OF K. E. TSIOLKOVSKIY IN THE FIELD OF ROCKET ENGINEERING S. P. Korolev p 4–15 refs (See N68-13575 04-28)

3. THE FIRST ROCKET AIRCRAFT IN THE USSR K. I. Trunov p 16–22 (See N68-13576 04-02)

4. ALL-UNION CONFERENCE ON THE USE OF JET AIRCRAFT IN MASTERING THE STRATOSPHERE Yu. V. Biryukov p 23–31 refs (See N68-13577 04-02)

5. HISTORY OF DEVELOPMENT OF SOVIET SEAPLANE AVIATION (PERIOD BEFORE THE SECOND WORLD WAR) K. F. Kosourov p 32–36 refs (See N68-13578 04-02)

N68-13576*# International Information, Inc., Philadelphia, Pa.
THE FIRST ROCKET AIRCRAFT IN THE USSR
K. I. Trunov *In its* Hist. of Aviation and Cosmonautics, Vol. 4 Nov. 1967 p 16–22 (See N68-13574 04-02)

An historical account is given of the designing and flight testing of rocket propelled gliders during the late 1930's and the early 1940's. Characteristics of the glider and rocket engine are tabulated, and the flight results are described. N.E.N.

N68-13577*# International Information, Inc., Philadelphia, Pa.
ALL-UNION CONFERENCE ON THE USE OF JET AIRCRAFT IN MASTERING THE STRATOSPHERE
Yu. V. Biryukov *In its* Hist. of Aviation and Cosmonautics, Vol. 4 Nov. 1967 p 23–31 refs (See N68-13574 04-02)

The conference sessions and papers are reviewed. The emphasis was placed on rocket engine technology, rocket planes using liquid propellants, and the combustion processes in liquid propellant rocket engines. Biomedical problems were also mentioned. N.E.N.

N68-13578*# International Information, Inc., Philadelphia, Pa.
HISTORY OF DEVELOPMENT OF SOVIET SEAPLANE AVIATION (PERIOD BEFORE THE SECOND WORLD WAR)
K. F. Kosourov *In its* Hist. of Aviation and Cosmonautics, Vol. 4 Nov. 1967 p 32–36 refs (See N68-13574 04-02)

The history of seaplanes from 1912 to World War II is briefly reviewed. Emphasis is placed on naval seaplanes, and mention is made of planes to be carried by submarines. Associated problems in hydrodynamics which were considered are indicated. N.E.N.

N68-13580*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
CONJUGATE GRADIENT METHODS WITH AN APPLICATION TO V/STOL FLIGHT-PATH OPTIMIZATION Interim Technical Report
R. K. Mehra and A. E. Bryson, Jr. Nov. 1967 37 p refs
(Grant NGR-22-007-068; Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(NASA-CR-91508; TR-543) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Conjugate gradient methods have recently been applied to some simple optimization problems and have been shown to converge faster than the methods of steepest descent. The present paper considers application of these methods to more complicated problems involving terminal as well as in-flight constraints. A number of methods are suggested to handle these constraints and the numerical difficulties associated with each method are discussed. The problem of flight-path optimization of a V/STOL aircraft has been considered and minimum time paths for the climb phase have been obtained using the conjugate gradient algorithm. In conclusion, some remarks are made about the relative efficiency of the different optimization schemes presently available for the solution of optimal control problems. Author

N68-13656 Vereinigte Flugtechnische Werke G.m.b.H., Munich (West Germany).
A CONTRIBUTION ON THE DETERMINATION OF OVERALL FORCES OF INCLINED PROPELLERS
B. Laschka, A. Mueller, and P. Ebeling [1963] 23 p refs

Propellers operating at an angle of attack with respect to free stream velocity experience appreciable airloads acting in all directions. The knowledge of the magnitude of these effects is important for the design of tilt propeller aircraft. Whereas the local force distribution over the blade is of minor importance, the overall forces of the whole propeller are of interest, especially if parametric studies are to be performed. An approach to determine these forces and moments in a quick and sufficiently accurate way is outlined. Besides the geometry of the blades only the theoretical or experimental performance charts of the propeller with zero incidence have to be available as basis for the calculations in terms of power and thrust coefficients versus advance ratio for different blade settings. A rough analysis of harmonics of higher order is possible. Comparison with experimental results of a tested propeller reveals good agreement even at high incidence and advance ratio. Author

N68-13675# Aeronautical Research Council (Gt. Brit.)
FLIGHT MEASUREMENTS OF THE ELEVATOR AND AILERON HINGE-MOMENT DERIVATIVES OF THE FAIREY DELTA 2 AIRCRAFT UP TO A MACH NUMBER OF 1.8 AND COMPARISONS WITH WIND-TUNNEL RESULTS
R. Rose, Q. P. Nicholas, Glynis Vorley London HMSO 1967 29 p refs Supersedes RAE-TR-65143; ARC-27376 See X68-10566 (ARC-R&M-3485; RAE-TR-65143; ARC-27376) HMSO: 15s 6d

Aileron and elevator hinge-moment derivatives have been extracted from flight tests on the Fairey Delta 2 in which the dynamic aircraft response to control pulses was recorded. Where possible the results are compared with wind-tunnel data. There is good agreement for the hinge moment due to control derivatives b_2 and the elevator b_1, whereas the results for aileron b_1 show differences from the tunnel values at supersonic speeds. b_0 could not be measured because of strain gauge drift; however consistent results were obtained for the aileron hinge moment induced by the elevator deflection and vice versa. At transonic speeds these terms are of similar magnitude to the conventional hinge moment derivatives b_1 and b_2, and must therefore be considered by designers. Author

N68-13761*# National Aeronautics and Space Administration, Washington, D. C.
HISTORY OF AVIATION AND COSMONAUTICS, VOLUME 2
N. D. Anoshchenko, ed. Nov. 1967 14 p refs Transl. into ENGLISH of the book "Iz Istorii Aviatsii i Kosmonavtiki. Vyp. 2" Moscow, 1964
(NASA-TT-F-11428) CFSTI: HC $3.00/MF $0.65 CSCL 01B

A brief summary of the development of U.S. launch vehicles is presented. The major figures and their contributions to Soviet gliding are discussed. The function of the Organizational Committee on the History of Aviation and Cosmonautics of the Ukraine is briefly described followed by a list of works on aviation history in the Ukraine. R.N.A.

N68-13824# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
QUANTITATIVE TERRAIN STUDY OF VTOL LANDING SITE DISTRIBUTIONS AND OF EFFECTS ON PENETRATION Final Report, Jul. 1, 1966–Jun. 30, 1967
W. F. Wood, H. L. Thung, and G. M. Lewandowski 30 Jun. 1967 114 p refs
(Contract AF 33(615)-3483)
(CAL-VE-2303-D; ASD-TR-67-18; AD-661592)

A VTOL site is assumed to require a ground slope of 10% or less and be clear of trees. Also there can be no boulders over 2 feet high or gullies deeper than 2 feet. Single sites, if square, should be 200 feet on a side and if circular 250 feet in diameter. Assault sites, if square, should be 1500 feet on a side and 2000 feet in diameter, if circular. Probability distributions of distances to single and assault sites, based on a study of environmental literature, topographic maps and aerial photographs are presented for Thailand, India, Nevada, Italy, Germany and Alaska. A VTOL site may be

expected within a few miles in all but the most unfavorable environments. Sites located on residual soils would seldom be too soft for VTOL operations, but alluvial soils should be avoided when poorly drained. Prior knowledge of analogous situations, aerial photography and direct observation provide the best information for evaluating candidate sites. Author (TAB)

N68-13843 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON ONE METHOD OF COMPUTATION USING AN ANALOGUE OF THE PITCH-ANGLE DISPERSION WITH MOTION OF AN AIRCRAFT IN A TURBULENT ATMOSPHERE [OB ODNOM SPOSOBE VYCHISLENIYA S POMOSHCH'YU ANALOGA DISPERSII UGLA TANGAZHA PRI DVIZHENII SAMOLETA V TURBULENTNOY ATMOSFERE]

Ye. A. Kuklev *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 12–24 refs (See N68-13851 04-28)

A method is outlined which uses analog simulation to estimate the effect of a turbulent atmosphere on the short-periodic motion of an absolutely rigid aircraft (with and without automatic pilot) in the longitudinal plane. As a criterion for estimating the aircraft's reaction to the atmospheric disturbances, the magnitude of pitch angle dispersion is selected for the case of steady horizontal flight at constant speed. The final result is presented in the form of a structural block diagram for simulating the basic equation. The unknown dispersion is read directly at the output of this block diagram. A fundamental assumption is that in horizontal flight the short-periodic motion of the aircraft in terms of pitch is perturbed only by the vertical component of wind velocity. This is small in comparison with the aircraft velocity, due to disturbance in the angle of attack. A further assumption is that the vertical wind velocity component is a random stationary function of time which is characterized by normal distribution, has zero mathematical expectancy, is subject to the theorem of ergodicity, and may be characterized by the single-dimensional spectral density. Author

N68-13846 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EQUATION OF MOTION OF AN AIRCRAFT FLIGHT-CONTROL SYSTEM: BOOSTER + CONTROL SURFACE + SPRING SERVO-COMPENSATOR [URAVNENIYA DVIZHENIYA SISTEMY UPRAVLENIYA POLETOM SAMOLETA: BUSTER PLUS RUL'—PRUZHINNYY SERVOKOMPENSATOR]

G. M. Trakhtenberg *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 42–54 (See N68-13841 04-28)

Inasmuch as two methods differing as to power are required for manual control of the aircraft flight and for automatic damping of its vibrations, a compromise method is suggested in which a hydraulic amplification is combined in one lower power unit with an auxiliary arrangement in the form of a spring servo-compensator. The operating characteristics of the servo-compensator are described and depicted. Equations of motion are derived for the booster valve, the dynamics of rudder control are considered, and the results are extended to the dynamics of aileron control. Second-order Lagrange equations are used for the computations which involve a determination of the kinetic energy of the system, and the generalized forces such as hinge moment relative to the axis of rotation of the rudder and the servo-compensator, and the compensator spring compression effort. M.G.J.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-12831* Atomics International, Canoga Park, Calif.

ALUMINIUM BONDED LEAD TELLURIDE THERMOELECTRIC MODULE RESEARCH AND DEVELOPMENT Summary Report, 1 May 1966–Jun. 1967

Jun. 1967 32 p

(Contract NAS5-10184)

(NASA-CR-91349; AI-67-132) CFSTI: $3.00 CSCL 10A

The process for contacting PbTe couples with directly bonded aluminum straps was investigated, and the potential of this method for the construction of nonmagnetic thermoelectric conversion modules suitable for long-term operation in space applications was demonstrated. All measurements and test results on contacted single elements, couples, and 3-couple modules demonstrated excellent initial power density (0.40 watt/couple) and efficiency (calculated 5.7%) for the temperature interval 750°F to 325°F. Test modules were constructed wholly of nonmagnetic materials. Life-test data, up to 3000 hours, show very promising stability, with power degradation rates ranging from zero at T_H =700°F to 3.2%/1000 hrs. at T_H=800°F. It is expected that the degradation rate will decrease significantly with longer operation. Author

N68-12907*# Ion Physics Corp., Burlington, Mass.

SOLAR CELL COVER GLASS DEVELOPMENT Quarterly Technical Progress Report, Dec. 1, 1966–Apr. 30, 1967

30 Apr. 1967 47 p refs

(Contract NAS5-10236)

(NASA-CR-91358; QTPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Both reactive sputtering and electron beam evaporation are being investigated for building up coverslip thickness, but neither of these processes is capable of depositing satisfactory thick layers of SiO_2. The reactively sputtered SiO_2 layers are hard and well bonded, but contain many optical scattering centers when thick films are produced. The scattering centers appear to be related to the manner in which the Si cathode is supported. Electron beam evaporated SiO_2 is well bonded, but soft and of poor quality. Electron beam evaporation of Al_2O_3 has, however, been quite encouraging. Integral coverslipped solar cells withstood rapid temperature cycling between −196 and +100°C. Cells with up to 4 mils of high vacuum sputtered SiO_2 were tested. Cells with 6 mils of high vacuum sputtered SiO_2 have been produced and rapidly temperature cycled between −196 and +100°C. Cells with 2 mil SiO_2 integral coverslips have been stored in a vacuum of $\approx 2\times10^{-7}$ torr for 500 hours at 100°C with no detectable loss in weight or significant electrical degradation. Author

N68-12910*# Brigham Young Univ., Provo, Utah. Dept. of Chemistry.

STUDIES OF REACTION GEOMETRY IN OXIDATION AND REDUCTION OF THE ALKALINE SILVER ELECTRODE Quarterly Report

E. A. Butler and A. U. Blackham 15 Nov. 1967 20 p refs Prepared for JPL

(Contracts NAS7-100; JPL-951911)

(NASA-CR-91448; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10C

A polarization curve of the silver anode in ammoniacal electrolyte suitable for use in comparing current density distribution data with a theoretical analysis of current density distribution was obtained. Attempts to use this system in a determination of surface area of a sintered silver electrode failed. Sintered silver electrodes consisting of spherical silver particles of known diameters were prepared, oxidized, and their effective electrolytic surface area was determined. These experimental surface areas agreed well with calculated areas when particles in the 24–48 micron size range were used, but agreement was not as good with smaller particles. Silver foil electrodes were oxidized with and without ultrasonic

vibrations to determine the effect these vibrations would have on the charging capacity. Increases of 8% and 25% observed for two different current densities are attributed to increased surface area caused by fracturing of the oxide layer by the vibrations. Author

N68-12923# Naval Research Lab., Washington, D. C.
SHIELDING OF SOLAR CELLS AGAINST VAN ALLEN BELT PROTONS
C. A. Carosella *In its* Rept. of NRL Progr. Aug. 1967 p 18–23 refs (See N68-12921 04-34)

A computer program has been written for use in determining the time needed to reduce the output power of a shielded solar cell by 25% when the cell is subjected to damage from protons in the Van Allen radiation belts. First, the change in an omni-directional differential spectrum of protons in space as a result of the protons passing through shields of various thicknesses is calculated. Then the life of the solar cell is determined by multiplying the new flux spectrum by the damage per particle at each energy for the solar cell and integrating the result over all energies. The time required to reduce the output power of a 1-ohm-centimeter, n-on-p, blue-sensitive solar cell by 25% has been calculated as a function of shield thickness for nine fused silica shields ranging in thicknesses from 10 to 1000 milligrams per square centimeter. The data of lifetime T in seconds versus shield thickness R fits the equation $T=4.8\times10^{3}\ R^{2.05}$ for thicknesses between 10 and 200 milligrams per square centimeter. Above 200 milligrams per centimeter, lifetime increases at a slower rate with increasing shield thickness. Author

N68-12939*# Ryan Aeronautical Co., San Diego, Calif.
FEASIBILITY STUDY 30 WATTS PER POUND ROLLUP SOLAR ARRAY Quarterly Report
10 Nov. 1967 339 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951971)
(NASA-CR-91445; Rept.-40067-1; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Work began with re-examination of the proposed solar array concept with reference to specification requirements and contract objectives. Subelements of the array were studied for more efficient use of material (lowest weight) versus function. Alternate designs of structural and mechanical arrangements were performed, substantiated by analysis. Solar cell layouts, materials and circuitry were selected for evaluation. Values for power per unit area and power per weight of electrical installation were developed for various solar cell designs, sizes and cover-glass use. Supporting technical analyses and studies included dynamics, thermal, stress, reliability and weights. The majority of work performed was directed to tradeoff studies. Manufacturing feasibility was investigated wherever gross size, foil gage fabrication techniques, or a unique process might present constraints. Design verification testing was performed on adhesives and film type plastics. Results of concept studies and design tradeoffs were summarized and a configuration selected for a more detailed preliminary design effort. This design is estimated to produce 31.3 watts per pound of weight, an estimate developed by conservative analysis, and allowing for design growth and contingency for normal tolerances. The concept, the materials and processes involved, are all considered to be within bounds of feasibility and state-of-the-art capability. Author

N68-12944* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF SONOTONE CORPORATION 3.5 AMPERE-HOUR NICKEL-CADMIUM CELLS
4 Aug. 1967 23 p
(NASA Order W-11252-B)
(NASA-CR-91293; QE/C-67-471) CFSTI: $3.00 CSCL 10C

The results of the acceptance tests are presented for the 3.5 ampere-hour sealed nickel–cadmium secondary spacecraft cells. Author

N68-12979* Thermo Electron Engineering Corp., Waltham, Mass.
HEAT PIPE THERMIONIC CONVERTER DEVELOPMENT Quarterly Report, 18 Jun.–12 Oct. 1967
12 Oct. 1967 13 p Prepared for JPL
(Contracts NAS7-100; JPL-951465)
(NASA-CR-91437; TE-4067-44-68) CFSTI: $3.00 CSCL 10A

Engineering design data are presented for an experimental heat pipe collector radiator structure. Although similar to three previous models, the heat pipe diameter was enlarged by using a custom made niobium tube to match the ceramic seal size and a larger radiator area of 38.3 cm^2 was developed. Engineering drawings and specific fabrication techniques are included and equations are given for predicting the radiator temperature for any values of output current. E.J.S.

N68-12989* Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF THERMIONIC ISOTOPE SPACE POWER TECHNOLOGY, APPENDIX 1 Final Technical Report
1967 187 p
(Contract NASw-1254)
(NASA-CR-91354) CFSTI: $3.00 CSCL 10A

A compilation of computer programs are presented which provide the following capabilities: (1) The IV (volt–ampere) curves, obtained in testing a thermionic converter, are analyzed and compared to one another and to curves obtained from other converters. (2) the optimum A/L ratio for heat dam construction over a range of currents and efficiencies are calculated and printed. (3) An actual IV curve is taken and used to calculate power losses in the system and the work function and efficiency of the converter. (4) The values of the pressures encountered in heat pipe operation are calculated and printed. (5) A table of values found in a heat pipe operating at given temperatures and conditions are calculated and printed. (6) The desired heat and proposed lead, heater and lead materials, temperature difference from end to end of the lead, and the current passing through the lead are used to calculate and print the A/L ratio, the current flow, and voltage drop. (7) The inside diameter of a pipe is calculated. Tabulations on the thermal properties of converter materials are included. M.G.J.

N68-13010* Sonotone Corp., Elmsford, N. Y.
CELL-CORE COMPRESSION STUDIES ON NICKEL-CADMIUM CELLS Final Report
G. Baumstark, S. Thornell, and A. Fitchman Nov. 1967 118 p
(Contract NAS3-6001)
(NASA-CR-72317) CFSTI: $3.00 CSCL 10C

Test data are presented on sealed nickel–cadmium cells in which the cell core assemblies were maintained at a known compression. The compression of these rectangular cell cores was accomplished by the incorporation of two leaf-type springs within the cell assembly. Static and dynamic tests were performed at various discrete compression forces, ranging from 0 psi to over 100 psi. Data compiled indicate that little, if any, change in the charge–discharge characteristic was achieved by variations in the force applied to compress the cell cores. However, there were definite indications that a cell under optimum compression may be immune to damage caused by prolonged over-discharge. Author

N68-13027# Battelle Inst., Frankfurt am Main (West Germany).
SORPTION OF GASEOUS HYDROCARBONS AT FUEL CELL CATALYSTS OF THE PLATINUM METAL GROUP Final Technical Report

Gerhard Wurzbacher Sep. 1967 48 p refs
(Contract DA-91-591-EUC-4035)
(AD-661381)

The chemisorption of propane and n-pentane on Raney platinum in the presence of varying amounts of pre-adsorbed water was studied at 100C by a combined gravimetric and mass spectrometric technique. It was found that the amount of saturated hydrocarbon chemisorbed is independent of the amount of pre-adsorbed water. If water is present on the surface, a portion of it is displaced upon chemisorption of hydrocarbons. At high coverages of the surface with pre-adsorbed water the amount of displaced water is constant. The ratio of displaced water molecules to chemisorbed propane molecules is about 1 with propane and 0.6 with n-pentane. If oxygen is chemisorbed on the catalyst surface before water and/or hydrocarbon is admitted, propane chemisorption is strongly enhanced. At a coverage of 1 oxygen atom for every 2 platinum surface atoms, the subsequent propane chemisorption is increased by a factor of about 2.5. Moreover, if on top of the oxygen layer water is adsorbed, the ratio of displaced water molecules to chemisorbed propane molecules is increased to 2. A qualitative scheme of surface reactions which is consistent with the observations is presented and the implications for the hydrocarbon fuel electrode are discussed. Author (TAB)

N68-13054 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NOVOCHERKASSK. POLYTECHNIC INSTITUTE
26 Apr. 1967 41 p refs
(FTD-MT-65-485; AD-655021)

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1. ACTIVE MASS OF ZINC-SILVER STORAGE BATTERY M. F. Skalozubov p 1-19 refs (See N68-13055 04-03)

2. INFLUENCE OF ULTRASONICS ON CERTAIN PROPERTIES OF NICKEL ELECTRODE OF ALKALINE STORAGE BATTERIES L. A. Kukoz and M. F. Skalozubov p 21-33 refs

N68-13055 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACTIVE MASS OF ZINC-SILVER STORAGE BATTERY [AKTIVNAYA MASSA TSINK SEREBRYANOGO AKKUMULYATORA]
M. F. Skalozubov *In its* Novocherkassk. Polytech. Inst. 26 Apr. 1967 p 1-19 refs (See N68-13054 04-03)

The following problems needing further investigation are mentioned after a survey has been made of the known properties of a Zn-Ag storage battery and of the methods of producing zinc and silver electrodes: processes on the zinc electrode, and improvement of the electrode; processes on the silver electrode; possibilities of producing a zinc-silver dry cell; replacement of the hydrate-cellulose partition by stabler films, e.g. films made of ion-exchange membrane or other materials; development of a thermal battery without CO_2 absorption, replacement of zinc by cadmium or another metal. Author

N68-13056 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF ULTRASONICS ON CERTAIN PROPERTIES OF NICKEL ELECTRODE OF ALKALINE STORAGE BATTERIES [VLIYANIYE ULTRAZVUKA NA NEKOTORYYE SVOYSTVA OKISNONIKELEVOGO ELEKTRODA SHCHELOCHNYKH AKKUMULYATOROV]
L. A. Kukoz and M. F. Skalozubov *In its* Novocherkassk. Polytech. Inst. 26 Apr. 1967 p 21-33 refs (See N68-13054 04-03)

A search to improve indices of an oxidized-nickel electrode with respect to capacity and period of service led to the investigation of using acoustic oscillations in the production of hydrated nickel oxide. Sources of acoustic oscillations were: barium titanate radiators, magnetostrictive converters, and electromagnetic vibrators. It was found that the imposition of acoustic oscillations during chemical precipitation of $Ni(OH)_2$ from solutions of nickel sulfate and caustic soda increases the utilization factor of nickel in anode mass by 10-20%. The greatest effect is rendered by ultrasonic oscillations of magnetostrictive range of frequencies (20-100 kc). The greatest amount of welling was revealed for hydrate sonicated by ultrasonics of frequency 20-100 kc. It was found that imposition of acoustic oscillations causes considerable change of granulometric composition of dry hydrated nickel oxide. Author

N68-13061* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS, CYCLE LIFE TEST
D. E. Mains 3 Nov. 1967 451 p
(NASA Order W-11252-B)
(NASA-CR-91289; QE/C-67-685; AR-3) CFSTI: $3.00
CSCL 10C

Sealed nickel-cadmium cells with rated capacities between 3.0 and 20 ampere hours were subjected to a life cycle test program to gather information on their use as secondary spacecraft cells. Cells were arranged into packs of 5 or 10 cells, and packs were cycled until more than half of the individual cells failed. Cycling test parameters included ambient temperature, charge voltage limit, percent depth of charge, percent of recharge, and orbit period; and the ampere-hour capacity of each pack was measured at approximately 88 day intervals. Of the original 84 packs, 58 failed; and the remaining packs completed between 978 and 1123 days of continuous cycling. In general, it was found that for the specified currents and orbit periods, 50°C was an unsatisfactory ambient temperature because of inefficient charge acceptance and unaccelerated separator deterioration. M.W.R.

N68-13086# Frankford Arsenal, Philadelphia, Pa.
A STUDY OF A GLASS FILAMENT-WOUND BODY FOR THE XM20 GAS GENERATOR
Lawrence G. Harkins Wright-Patterson AFB, Ohio Systems Eng. Group Sep. 1967 38 p
(FA-R-1862; SEG-TR-67-39; AD-661566)

The report covers a study to determine the applicability of a glass filament-wound gas generator body (GFGG) to the XM20 gas generator development program. The results of the study indicated that the filament-wound construction, possessing high strength-to-weight ratio characteristics, was an ideal approach to the development of a lightweight gas generator body capable of withstanding a peak internal pressure of 2000 psi. The present filament-wound gas generator body weighs approximately 3.7 lb compared with 5.8 lb for an aluminum generator. It affords a safety factor of 300% based, not on the filament-wound shell structure, but on the bond strength between the adapter cap and the filament-wound shell. On the basis of the promising results achieved by this study, it is recommended that the glass filament-wound fabrication technique be considered for other propellant actuated device (PAD) applications where high strength-to-weight ratios, high length-to-diameter ratios, and ease of fabrication are principal requirements. Author (TAB)

N68-13094# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STATUS AND PERSPECTIVES OF DEVELOPING MAGNETOHYDRODYNAMICS GENERATORS [SOSTOYANIYE I PERSPEKTIVY RAZVITIYA MAGNITOGIDRODINAMICHESKIKH GENERATOROV]

A. I. Moskuitin 18 Apr. 1967 42 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Energ. Inst. Vopr. Razvitiya Energ. (USSR), 1964 p 58–79
(FTD-HT-66-378; AD-661771)

As is evident from the explained matter, work on MGD generators in world technology has sharply progressed in recent years. According to conduction generators with thermal equilibrium ionization, in the most theoretically and experimentally processed, powers of experimental samples were obtained of up to 1350 kw. Probably, in the relatively close future, experimental stations of thermal power will be built of the order of 150–250 mw, although there are still many problems to be solved, mainly pertaining to materials. In this connection, reports are presented on further increase in electro-conductivity, expansion of temperature boundaries, reduction of dimensions and increase in effectiveness on the basis of nonequilibrium ionization, pulsating flow of plasma and transition to electrodeless systems. Author (TAB)

N68-13101*# Boeing Co., Seattle, Wash. Space Div.
DEVELOPMENT OF SOLAR-PANEL SYSTEM FOR THERMALLY ANNEALING RADIATION DAMAGED SOLAR CELLS Quarterly Progress Report, 1 Jul.–1 Oct. 1967
1 Oct. 1967 38 p refs
(Contract NAS5-10445)
(NASA-CR-91390; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The work accomplished during this first quarter included: (1) development of a thermal-diffusion bonding process for attaching silver interconnectors to solderless, silicon solar cells, (2) evaluation of 400-Hz motor operations in vacuum, (3) a thermal analysis to evaluate possible heating methods, and (4) a preliminary panel design. Author

N68-13216*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
THIN-FILM GAAS PHOTOVOLTAIC SOLAR ENERGY CELLS Final Report
P. A. Crossley, R. B. Gill, A. Spielman, and M. Wolf 28 Aug. 1967 102 p refs
(Contract NAS3-8510)
(NASA-CR-91436) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The results of experimental work aimed at improving device conversion efficiency are reported. Measurements of the optical and electrical properties of cuprous selenide layers, and electrical measurements on the barrier contact characteristics, were made. The operating characteristics of the cells are described, including the results of a stability testing program, and the development of a successful antireflection coat. A review of all previous work under related contracts is also given. Author

N68-13221# Tyco Labs., Inc., Waltham, Mass.
STUDY OF THERMOELECTRIC AND THERMIONIC POWER CONVERSION Final Report, Feb. 1, 1966–Jan. 31, 1967
R. Jasinski and Fritz Wald Oct. 1967 235 p refs
(Contract N00014-66-C-0147)
(AD-661455)

The state-of-the-art of thermoelectric and thermionic power conversion is discussed. The report is intended to bridge the gap between the producers and researchers active in the field and the potential users of the devices. Emphasis is placed on those problem areas inhibiting further exploitation of the fields, in particular, materials problems. The anticipated trends in research and development for the near future are defined. Author (TAB)

N68-13228# Burgess Battery Co., Freeport, Ill.
DEVELOPMENT OF MAGNESIUM WAFER CELLS Quarterly Report, 1 Feb.–30 Apr. 1967
Lloyd W. Eaton Oct. 1967 19 p
(Contract DA-28-043-AMC-02135(E))
(QR-4; ECOM-02135-4; Rept.-4; AD-661642)

Battery units were made that survive two weeks storage at 160F. Battery units stored one month at 160F suffered a complete degradation of the cell wrap necessitating a review of the construction with respect to materials and assembly to protect the cell wrap and anode moisture barrier contact. The most likely material changes that will produce early results are use of an experimental proprietary plastic film as cell wrap or the replacement of the rolled tin plated steel vapor barrier with a copper foil vapor barrier. The addition of a polyester film separator between the moisture barrier and cell wrap on the anode side is also to be considered even though the complexity of the cell is greatly increased. Author (TAB)

N68-13435*# Franklin Inst., Philadelphia, Pa. Research Labs.
A STUDY OF PACKAGING AND SHIPPING PROCEDURES FOR SMALL ELECTROEXPLOSIVE DEVICES Final Report, May 1, 1966–Aug. 1, 1967
C. T. Davey and W. J. Dunning 1 Aug. 1967 107 p refs
(Contract NAS1-6280)
(NASA-CR-66523; F-C1853) CFSTI: HC $3.00/MF $0.65 CSCL 19A

The sensitivity, environment, and response of electric initiators and their explosive components are analyzed. Responsiveness in the natural and packaged states to heat and electrical and mechanical stimuli are considered. Environment is defined in terms of best available information on storage temperatures; lightning, radio frequency, and static electricity; and the mechanical stimuli that an electroexplosive device can receive in normal shipment. It is concluded that present ICC regulations consider safety of the carrier and the general public, but do not provide for the electrical safety of the devices being shipped or for adequate protection of the reliability of the electric initiators. It is recommended that shielding be provided for initiators in transit and in storage. Metal foils should be used, and more suitable designs for shielding from low-frequencies should be developed for use in the future to enhance safety and reliability. Author

N68-13488# Naval Ship Engineering Center, Philadelphia, Pa.
DEVELOPMENT OF A FLUIDIC SPEED/LOAD CONTROLLER FOR A MOTOR-GENERATOR SET
David L. Greene 19 Oct. 1967 32 p ref
(NAVSEC-X-01; AD-661462)

Using pure fluidic devices, a controller was developed to maintain constant speed of a motor-generator set over a wide range of generator loads. Additionally, an electronic torque measurement was integrated with the fluidic controller to provide a load limiting capability. The motor-generator set consisted of an air motor and automobile generator, analogous to a steam driven electric generator. The speed controller demonstrated a slight droop characteristic for large loads, indicating that the desired proportional plus integral control had not been completely achieved. Author (TAB)

N68-13611*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERNAL TEMPERATURES AND GASSING CHARACTERISTICS OF A NiCd CELL FOR 37 PERCENT DEPTH OF DISCHARGE, 90-MINUTE CYCLING

E. F. Colston Dec. 1967 14 p
(NASA-TM-X-63067; X-716-67-610) CFSTI: HC $3.00/MF $0.65 CSCL 10C

An experimental 12-ampere-hour, nickel–cadmium electrochemical cell with eight internally mounted thermocouples was constructed and cycled on a 90-minute orbit. For a 37 percent D.O.D. orbit and 1.49-volt circuit, the internal temperature varied from 1.75C° above ambient (room temperature) at the end of discharge to 1.25C° below ambient after 30 minutes of charging. The temperature gradient for the plate stack averaged about 1C°, with the geometric center being the warmest position and the lower plate stack corners being the coolest. The reverse charging (5 amperes) of the cell yielded two voltage plateaus. The first plateau occurred at −0.1 to −0.3 volts, with the cell gassing hydrogen. Stopping the reverse charging at this point allows the cell to recover to a positive (normal, although less than 1 volt) voltage. However, if the reverse charging current is stopped at the second plateau (occurring at −1.56 volts with hydrogen and oxygen being liberated), the cell voltage would remain negative for several days.
Author

N68-13636*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
ELECTROCHEMICAL CHARACTERIZATION OF NONAQUEOUS SYSTEMS FOR SECONDARY BATTERY APPLICATION Quarterly Report, Aug.–Oct. 1967
M. Shaw, O. A. Paez, and A. H. Remanick 17 Nov. 1967 67 p refs
(Contract NAS3-8509)
(NASA-CR-72349; QR-6) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Multisweep cyclic voltammograms have been obtained for an additional 161 systems comprising zinc, cadmium, molybdenum, indium, iron, vanadium, chromium, and manganese electrodes in dimethylformamide, and propylene carbonate solutions of chlorides, perchlorates, and fluorides. Voltammograms are presented for twenty-two of these systems. Tabular data includes peak current density, sweep index, anodic-to-cathodic peak displacement, coulombic ratio, and discharge capacity. Systems exhibiting neither anodic nor cathodic peaks are listed, as well as those causing instrument overload due to a combination of high current and relatively low conductance.
Author

N68-13748* Naval Ammunition Depot, Crane, Ind.
SPACE CELL TEST PROGRAM Monthly Progress Report, 30 Jun. 1967
5 Dec. 1967 268 p
(NASA Order W-11252-B)
(NASA-CR-91563) CFSTI: $3.00 CSCL 10A

Life cycle test data are presented for nickel–cadmium cells, in both 10- and 5-cell packs. The test parameter and precycling capacity test description are included.
N.E.N.

N68-13816* Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
POWER SUPPLIES USING HIGH FREQUENCY MODULES Final Report
E. F. Swiderski and J. R. Nocera Feb. 1967 109 p refs
(Contract NAS3-7108)
(NASA-CR-54871; WAED-67-10E) CFSTI: $3.00 CSCL 10A

The results of a development program to design, test, and evaluate high frequency dc to dc converter modules for ion thrustor systems are presented. Three converter modules, designed for vacuum operation, were fabricated. One of these modules was tested at atmospheric conditions. The test results showed the converter voltage regulation was satisfactory. The measured output voltage ripple was 15% and the conversion efficiency was 80%.
Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-12847*# IIT Research Inst., Chicago, Ill.
LIFE IN EXTRATERRESTRIAL ENVIRONMENTS Quarterly Status Report, 1 Sep.–30 Nov. 1967
Charles A. Hagen 30 Nov. 1967 17 p refs
(Contract NASr-22)
(NASA-CR-91291; IITRI-L6032-11) CFSTI: HC $3.00/MF $0.65 CSCL 06F

B. cereus and *S. aureus* survived in various severe environments for at least 12 months with no appreciable decrease in the number of viable cells. Barometric pressure, carbon dioxide concentration, and length of daily freeze influenced the growth response of both organisms. The 100% carbon dioxide environment at 10 mb with a 20-hr daily freeze allowed survival with no appreciable die off of *B. cereus*. Growth of *S. aureus* occurred in the same environment, with final counts about 4-fold higher than initial counts. Barometric pressure and length of daily freeze affected the growth of *S. aureus* in environments with low water activities (a_w). The lowest a_w range thus far tested that permitted growth was 0.70 to 0.75. Preliminary data from soil ecology experiments indicated that the a_w of the environment is important to survival. As the a_w decreased, a greater number of cells was required for suvival.
Author

N68-12925# School of Aerospace Medicine, Brooks AFB, Tex.
GROWTH OF THE YOUNG MALE RAT IN A HYPEROXIC ENVIRONMENT
Methodius J. Bartek, Murphy B. Daniels, and Frode Ulvedal Sep. 1967 27 p refs
(SAM-TR-67-82; AD-661978)

Young male rats were maintained continuously in a hyperoxic environment for periods up to 8 weeks. During this time, the animals were subjected to an oxygen partial pressure of 369 mm. Hg (97.1%) at a simulated altitude of 380 mm. Hg (18,000 ft). The parameters chosen to delineate growth and development in the rat were: total body weight gain; weight gain of the liver, kidney, testis, spleen, lung, adrenal, heart, and brain; deoxyribonucleic acid (DNA), ribonucleic acid (RNA), and protein content of these organs; incorporation of 14C-leucine into liver protein; and serum lactate dehydrogenase (LDH) isozymes. In spite of the changes reported in the text, the animals grew well in this atmosphere; however, it should be noted that several fundamental changes were observed in the growth and development on the cellular level.
Author (TAB)

N68-12946*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STERILIZATION: A SELECTED BIBLIOGRAPHY FROM THE LITERATURE RETRIEVAL SYSTEM, SPACE BIOLOGY BRANCH
Nov. 1967 40 p refs Revised
(NASA-TM-X-63054; X-624-67-564, Rev.; X-450-68-53) CFSTI: HC $3.00/MF $0.65 CSCL 06T

An annotated bibliography is presented with topical headings. These headings include: (1) clean rooms; (2) decontamination; (3) sterilization methods, i.e., air filtering, chemicals, radiation and heat; (4) methods and statistics for detection and monitoring of microorganisms; (5) spacecraft sterilization; and (6) survival viability of microorganisms. D.T.

N68-12952# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
ACCLIMATIZATION VERSUS TOLERANCE TO STRESS, VOLUME 1 An Annotated Bibliography, May 1964–Jul. 1965
J. T. Celentano, H. B. Kelly, Jr., and W. I. Lilley Brooks AFB Tex. School of Aerospace Med. Sep. 1967 561 p refs Submitted for publication
(Contract AF 41(609)-2335)
(SAM-TR-67-95, V. 1; AD-661571)

The bibliography was prepared from the literature surveyed as part of the study to determine the effect of altitude acclimatization on various selected stresses. This volume contains a compilation of titles and abstracts on altitude acclimatization and the exposure to chronic hypoxia. The bibliography is arranged alphabetically by last names of authors. Author (TAB)

N68-12953# McGill Univ., Montreal (Quebec).
STUDIES OF THE EFFECTS OF MANIPULATION OF BRAIN METABOLISM ON LEARNING. 1: VITAMIN B12. 2: MAGNESIUM PEMOLINE (CYLERT). 3: MALONONITRILE DIMER (U9189). 9: ANODAL POLARIZATION Final Report, 6 Jul. 1966–5 Jul. 1967
John A. Corson Holloman AFB, N. Mex. Aeromed. Res. Lab. Oct. 1967 58 p refs
(Contract AF 29(600)-5685)
(ARL-TR-37-18; AD-660565) CFSTI: HC $3.00/MF $0.65

Male rats were subjects in experiments on the effects of various chemical and electrical interventions on learning ability. The studies used a variety of behavioral testing situations ranging from simple escape to pattern discrimination. The following behavioral results were obtained: (1) vitamin B12 improved the learning of hooded rats in simple escape and pattern discrimination situations, (2) magnesium pemoline improved some types of performance, primarily those with speed components, and interfered with others, (3) malononitrile dimer had a generally detrimental effect on performance, the one exception being an improvement in one phase of spatial learning, and (4) in pilot experiments using small groups, anodal polarization of cortical tissue had no significant effect. The following chemical results were obtained: (1) vitamin B12 increased the concentration of RNA in the nucleoli of neurons in the cerebellum and spinal cord, (2) magnesium pemoline did not change the amount of C14 formate incorporated into newly synthesized RNA, and (3) malononitrile dimer increased incorporation of C14 formate into newly synthesized RNA. General conclusions are as follows: (1) elevation of neural RNA is not necessarily accompanied by improvements in learning ability, and (2) patterns of change in brain metabolism and learning ability produced by these interventions demonstrate the inadequacy of several theories and may eventually lead to an increased understanding of the biological basis of learning. Author (TAB)

N68-12963*# Naval School of Aviation Medicine, Pensacola, Fla.
THE EFFECT OF WATER IMMERSION ON PERCEPTION OF THE OCULOGRAVIC ILLUSION IN NORMAL AND LABYRINTHINE-DEFECTIVE SUBJECTS
Ashton Graybiel, Earl F. Miller, II, Bernard D. Newsom, and Robert S. Kennedy 14 Sep. 1967 19 p refs
(NASA Order R-93)
(NASA-CR-91451; NAMI-1016) CFSTI: HC $3.00/MF $0.65
CSCL 06S

The separate and combined influences of otolith and nonotolith sensory inputs upon perception of the oculogravic illusion were investigated by manipulating the visual and gravitoinertial force environments. By comparing the visually perceived direction of space by four naval aviators and four deaf persons with bilateral labyrinthine defects when dry and when immersed in water up to neck level, the contributions of (1) field force receptors in the vestibular organs and (2) non-vestibular proprioceptors stimulated by external contact support could be differentiated. Under these various conditions it was found that in normal persons, the vestibular contribution is predictable in terms of the direction of the gravitoinertial force vector but that the nonvestibular contribution varies; it may be relatively great or small. In persons with bilateral labyrinthine defects a nonvestibular contribution was always present but there was great individual variance. The significance of the findings in terms of tests measuring the function of the otolith organs is discussed. Author

N68-12977# Sperry Rand Research Center, Sudbury, Mass.
SUPPRESSION AND FUSION IN STEREOPSIS Final Report, 1 Aug. 1964–31 Jul. 1967
Lloyd Kaufman Sep. 1967 192 p refs
(Contract DA-49-193-MD-2654)
(SRRC-CR-67-36; AD-661647)

The behavioral studies reports have led to the conclusion that sensory fusion of disparate binocular stimuli cannot be distinguished from suppression. Singleness of vision under these circumstances may be attributed to the suppression of parts of each eyes input. The stimulus dimension most relevant to stereopsis appears to be disparity in relative brightness. Moreover, stereopsis can occur when the contours imaged on the two retinas are rivalrous. Hence rivalry is not incompatible with stereopsis. Brightness disparities may be superposed on any pattern of contours, even those which are classically deemed fusable, and stereopsis may be predicted from the distribution of brightness. Although contour is not necessary to the occurrence of stereopsis, recent evidence suggests that it may be sufficient. It would appear that two parallel systems can operate to mediate binocular depth perception: a system which includes a spatial brightness-averaging mechanism and a system which includes a contour processing mechanism. Both systems involve a scheme which entails correlation of arrays along either a brightness or a contour dimension. Hence some form of monocular pattern recognition may occur during stereopsis. An effort was made to verify reports of others that rivalry is accompanied by changes in the evoked response. This was not verified in a number of experiments. Nonlinear interaction between inputs to corresponding places to the two eyes will occur regardless of the nature of the stimuli. Author (TAB)

N68-12983# Kansas State Univ., Manhattan.
VISION RESEARCH IN MILITARY AND GOVERNMENT LABORATORIES
John Lott Brown Dec. 1967 27 p refs
(Contract Nonr-3634(04))
(AD-661870)

Contents: Summary of laboratories by services (U. S. Air Force, U. S. Army, U. S. Navy, NASA); Special visual problems associated with military operations (aircraft landing; low-altitude, high-speed flight; continuous visual control); Optical aids; Visual displays; Search, detection, recognition, and reconnaissance; Information displays; night vision; flash blindness; various stresses; visually-guided control functions; space flight; special processing of visual information; longitudinal studies; psychophysical studies of vision; electrophysiology; ocular-vestibular effects; Standards, testing, and screening. TAB

N68-13004# North American Aviation, Inc., Downey, Calif. Life Systems Dept.
ACCLIMATIZATION VERSUS TOLERANCE TO STRESS, VOLUME 2 AN ANNOTATED BIBLIOGRAPHY
J. T. Celentano, H. B. Kelly, and W. I. Lilley Brooks AFB, Tex. School of Aerospace Med. Sep. 1967 245 p refs
(Contract AF 41(609)-2335)
(SAM-TR-67-95, V. 2; AD-661572)

The volume is a continuation of the literature survey (AD-661 571) conducted to evaluate acclimatization versus tolerance to stress and contains a compilation of titles and abstracts dealing with altitude acclimatization as related to acute hypoxia, decompression, hypercapnia and hyperthermia. The bibliography is arranged alphabetically by authors names. Author (TAB)

N68-13042# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PERIPHERAL OR LOCAL REFLEXES
M. V. Sergiyevskiy 13 Mar. 1967 227 p refs Transl. into ENGLISH of the book "Perifericheskiye Ili Mestnyye Refleksy" Moscow, Izd. Med., 1964 p 1–200
(FTD-HT-66-685; AD-661895)

Contents: Basic histological data on sensory-nerve endings in the internal organs and the possibility of reflex-arc completion in the peripheral ganglia; Peripheral, or local reflexes and axon reflexes; Observations on isolated pelvic and digestive organs; Reactions of the urinary bladder to changes in pressure in the inferior mesenteric artery; Reflexes from the abdominal vessels to the spleen; Reflexes from the abdominal vessels to the kidneys; Lymphopoietic reflexes originating in the vascular receptor fields of the abdomen; Biligenetic reflexes originating in the abdominal vessels; Results of parallel observations of biligenesis and lymphopoiesis during changes in pressure in the abdominal arteries and organs; Brief summary and prospects for further resolution of the problem of peripheral reflexes. TAB

N68-13100# Naval Medical Research Inst., Bethesda, Md. Translation Service.
ELECTRON-STIMULATED STATES OF THE BIOPOLYMERS. CHAPTER 2: ELECTRON-STIMULATED STATES OF PROTEINS
S. V. Konev 1965 64 p Transl. into ENGLISH from the book "Elektronno-Vozbuzhdennye Sostoyaniya Biopolimerov" Minsk, Nauka i Tekhn., 1965 p 56–96
(Rept.-1203; AD-661174)

Topics include: Fluorescence of proteins containing tyrosine; Fluorescence of proteins containing tryptophan; Spectra of protein fluorescence; Quantum output fluorescence and protein macrostructure; Conformation and luminescence of proteins; Duration of the stimulated state of protein fluorescence; polarization spectrum of protein fluorescence after absorption; Polarization spectra of protein fluorescence after emission; Fluorescence of albumins; Life span of albumin phosphorescence; Polarization spectra of protein phosphorescence after absorption and emission. TAB

N68-13107# Naval Medical Research Inst., Bethesda, Md.
ETIOLOGY OF DECOMPRESSION SICKNESS: CHARACTERISTICS OF BUBBLE FORMATION IN VIVO
Richard G. Buckles 9 Aug. 1967 32 p refs Presented at the Biomed. Eng. Symp., San Diego, Calif., 19 Jun. 1967
(Rept.-1; AD-661841)

In order to permit the testing of new decompression procedures in a reasonable time frame, a scaled animal preparation was developed. The technique permits the direct observation of bubble formation in vivo under highly controlled environmental conditions. This report presents the basis for such scaling and describes the instrumentation system that was developed. Author (TAB)

N68-13116* Pillsbury Co., Minneapolis, Minn.
MANUFACTURE AND TEST OF HIGH DENSITY FOOD PRODUCTS Final Report
Oct. 1967 33 p
(Contract NASw-1627)
(NASA-CR-91375) CFSTI: $3.00 CSCL 06H

Performance, acceptability, ease of preparation, and packaging of high density foods was evaluated on field trips to high mountain ranges and on arctic expeditions. Menu configurations contained about 4.50 to 4.79 calories/gram in compressed food bars, and consisted of frozen meat, rice, mashed potatoes, corn flakes, and milk. All foods proved extremely satisfactory in keeping the expedition members strong and healthy; but participants expressed a desire for more varied menus. G.G.

N68-13160* Franklin Inst., Philadelphia, Pa. Research Labs.
BLEPHARISMA GROWTH IN "NULL" MAGNETIC FIELD Final Report
R. J. Gibson, I. R. Isquith, and R. M. Goodman 31 Jul. 1967 104 p refs
(Contract NSR-39-005-020)
(NASA-CR-91399; F-B2375) CFSTI: $3.00 CSCL 06F

A slow-moving heterotrichous ciliate, Blepharisma intermedium, was studied to determine the effects of magnetic field on cells. Since the culture included bacteria necessary as a food supply for the Blepharisma, observed effects due to the lack of magnetic field must take into account the role played by the bacteria. Even though the magnetic diminution may have affected the growth of the Blepharisma, no drastic cytological changes were observed. The only possible cytological difference was that the cells grown under ambient conditions seemed slightly longer than those from the null field. If this is actually the case, it may be an indication that null field cells are dividing faster and, therefore, producing slightly smaller cells than the controls. Clonal frequencies and averages are discussed, and data from 30 clonal experiments are summarized. M.W.R.

N68-13181# Joint Publications Research Service, Washington, D. C.
SPACE BIOLOGY AND MEDICINE, VOLUME 1, NO. 4, 1967
19 Dec. 1967 180 p refs Transl. into ENGLISH of Kosmich. Biol. i Med. (Moscow), v. 1, no. 4, 1967 p 1–88
(JPRS-43762)

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3. CONTINUOUS CULTURE OF MICROALGAE AS PART OF A CLOSED ECOLOGICAL SYSTEM L. V. Kirenskiy, I. A. Terskov, I. I. Gitel'zon, G. M. Lisovskiy, B. G. Kovrov et al p 26–31 refs (See N68-13184 04-04)

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5. PROLONGED CHLORELLA CULTIVATION WITH DIRECT RECOVERY OF THE MEDIUM G. I. Meleshko, Ye. K. Lebedeva, O. A. Kurapova, and Yu. N. Ul'yanin p 41–47 refs (See N68-13186 04-04)

6. DETERMINATION OF THE BIOLOGICAL VALUE OF ALGAL AND SOYBEAN PROTEINS IN WHITE RATS OF FOUR GENERATIONS N. S. Klyushkina, V. I. Fofanov, and I. T. Troitskaya p 48–52 refs (See N68-13187 04-04)

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9. REACTIVITY OF ANIMALS TO CAFFEINE AND STRYCHNINE IN THE PERIOD OF AFTEREFFECT TO TRANSVERSE ACCELERATIONS V. Ye. Belay, P. V. Vasil'yev, G. D. Glod, and M. I. Bryuzgina p 72–81 refs (See N68-13190 04-04)

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11. OF THE EFFECT OF ELIMINATION OF AFFERENT SIGNALIZATION ON THE TONIC FUNCTION OF SKELETAL MUSCLES M. N. Murav'yev p 95–102 refs (See N68-13192 04-04)

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14. CHANGE OF THE PSYCHOPHYSIOLOGICAL STATE OF THE BODY BY AUTOGENOUS AND EXOGENOUS SUGGESTION G. I. Gurvich, V. L. Marishchuk, M. I. Tishchenko, G. D. Yefimenko, and B. S. Khvoynov p 114–118 refs (See N68-13195 04-04)

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16. A METHOD FOR USING AN ELECTRONIC COMPUTER FOR DETERMINING SOME MOTION CHARACTERISTICS IN BIOMECHANICAL INVESTIGATIONS B. A. Dushkov, V. P. Produnov, and S. A. Kosilov p 126–134 refs (See N68-13197 04-05)

17. COORDINATION STRUCTURE AND RECONSTRUCTION PHASES OF MOTOR HABITS UNDER CONDITIONS OF WEIGHTLESSNESS AND ACCELERATIONS I. F. Chekirda p 135–141 refs (See N68-13198 04-05)

18. EFFECT OF AN ELECTRICAL STIMULUS ON THE REACTION OF THE HUMAN VESTIBULAR APPARATUS CAUSED BY ACCLERATION G. V. Voronin p 142–152 refs (See N68-13199 04-04)

N68-13182# Joint Publications Research Service, Washington, D. C.

THE PROBLEM OF SENSORY DEPRIVATION IN SPACE MEDICINE

F. P. Kosmolinskiy *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 1–13 refs (See N68-13181 04-04)

A brief review is given of the principle results in various studies of human adaptation to prolonged space flight. Interrelationships of afferent systems of the body with different forms of sensory deprivation are depicted for: (1) isolation of the individual accompanied with restriction of external afferentation; (2) limited motor activity in a space with limited volume; (3) weightlessness; and (4) a general decrease of the flux of external afferentation under monotonic conditions for the human body. G.G.

N68-13183# Joint Publications Research Service, Washington, D. C.

EXTRALABYRINTHINE SYMPTOMS OF MOTION SICKNESS UNDER SPACE FLIGHT CONDITIONS

I. M. Khazen *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 14–25 refs (See N68-13181 04-04)

This paper criticizes hypotheses on the dominant role of the vestibular apparatus in the genesis of so-called space motion sickness which have had wide acceptance for many years. On the basis of experimental data the paper gives an analysis of nervous and humoral mechanisms of extralabyrinthine effects on the development of autonomic disturbances during exposure of the human body to space flight factors. Author

N68-13184# Joint Publications Research Service, Washington, D. C.

CONTINUOUS CULTURE OF MICROALGAE AS PART OF A CLOSED ECOLOGICAL SYSTEM

L. V. Kirenskiy, I. A. Terskov, I. I. Gitel'zon, G. M. Lisovskiy, B. G. Kovrov et al *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 26–31 refs (See N68-13181 04-04)

It is recommended that a continuous culture of unicellular algae grown with a constant density of the suspension be used as an autotrophic component of a closed ecological system. It is shown that under such conditions the stabilized concentration of the culture biomass causes a stability of every chemical parameter of the medium and culture productivity. An experimental cultivator with an automatic stabilization of the biomass concentration and culture temperature has been designed to meet the oxygen requirements of a single man. It is demonstrated that the efficiency with which the algal culture can use solar and artificial light is similar. Author

N68-13186# Joint Publications Research Service, Washington, D. C.

PROLONGED CHLORELLA CULTIVATION WITH DIRECT RECOVERY OF THE MEDIUM

G. I. Meleshko, Ye. K. Lebedeva, O. A. Kurapova, and Yu. N. Ul'yanin *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 41–47 refs (See N68-13181 04-04)

This article describes a method for prolonged cultivation of Chlorella which has none of the disadvantages typical of the classical continuous culture method. In addition, it has advantages over the batch method. The data show that the direct method for recovery of the medium provides for necessary removal of insoluble products of algal and bacterial cell dissociation from the suspension. At the same time it stabilizes the content of soluble organic substances at a level which causes no decrease of productivity. Author

N68-13187# Joint Publications Research Service, Washington, D. C.

DETERMINATION OF THE BIOLOGICAL VALUE OF ALGAL AND SOYBEAN PROTEINS IN WHITE RATS OF FOUR GENERATIONS

N. S. Klyushkina, V. I. Fofanov, and I. T. Troitskaya *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 48–52 refs (See N68-13181 04-04)

White rats of four generations were used to study the effect exerted on the animal body by a diet with a bleached biomass of unicellular protococcal algae and soybean flour as the only protein source. The diet contained 18% proteins. Algal proteins showed a high biological value. Test animals exhibited no significant changes in the concentration of amine nitrogen in the urine, nitrogen balance, nitrogen and fat content in the liver and albumin concentration in the blood as compared with the control rats (fed diets containing casein). The biological value of soybean proteins appeared to be considerably lower than that of algal proteins. Author

N68-13189# Joint Publications Research Service, Washington, D. C.

REACTIVITY AND TOLERANCE OF WARM-BLOODED ANIMALS

L. L. Marfina *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 60–71 refs (See N68-13181 04-04)

Studies on the tolerance of rats in a hypothermal state to very low atmospheric pressure were made. The hypothermal state was induced either by an exposure of the animals to increasing hypercapnia–hypoxia (cooling to 32–16°C) or by their premedication with lytic mixtures (cooling to 21–18°C). The total time of "ascent", "plateau" and "descent" of the rats in an altitude chamber was 15 minutes. Reduction of the reactivity of the animals was accompanied by a significant increase of their tolerance to hypoxic hypoxia. There was no noticeable difference in animal tolerance during the hypothermia brought about by the two methods. The rats which were fixed when exposed to hypoxic hypoxia revealed a slightly decreased tolerance, although the general trend towards an increase of tolerance in relation to the degree of hypothermia remained unchanged. Author

N68-13190# Joint Publications Research Service, Washington, D. C.

REACTIVITY OF ANIMALS TO CAFFEINE AND STRYCHNINE IN THE PERIOD OF AFTEREFFECT TO TRANSVERSE ACCELERATIONS

V. Ye. Belay, P. V. Vasil'yev, G. D. Glod, and M. I. Bryuzgina *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 72–81 refs (See N68-13181 04-04)

Chronic experiments on rabbits and dogs were carried out to study the characteristics of the pharmacological action of caffeine and strychnine during the period of aftereffect to transverse accelerations. The experiments revealed a decrease of the stimulant effect of the analeptics on the cardiac activity and respiration 5 to 25 minutes after exposure of the animals to accelerations. They also revealed a reduction of the stimulant effect of strychnine of the rate of spinal reflexes. These data make it possible to conclude that normalization of the ECG and respiratory indices used as indicators of the animal tolerance to accelerations cannot give evidence of a complete functional recovery of the animal body. Author

N68-13191# Joint Publications Research Service, Washington, D. C.

DEOXYGENATION OF THE BODY DURING ASCENT

Ye. A. Kovalenko *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 82–94 refs (See N68-13181 04-04)

Experiments were carried out on 21 dogs given a low amobarbital sodium anesthesia. The values of the pO_2, pCO_2 and pH in the arterial and venous blood of the brain and in the mixed venous blood of the pulmonary heart were measured during exposure of the animals to simulated altitudes of 4, 6, 8, 10 and 12 km. In addition, the ECG, respiration rate and EEG of the cerebral cortex and subcortical formations were recorded. Ascents to altitudes of 8 km or more at a rate of 20 m/sec caused a faster and lower decrease of pO_2 in the arterial blood than in cerebral venous blood and in the mixed venous blood. This indicates development of an altered gas exchange process, which is called deoxygenation of the body. The process promotes a distinct acceleration of acute hypoxic hypoxia at certain altitudes, in level. Calculations of the pO_2 decrease in the tissues of the cerebral cortex performed on a model of the tissue capillary cylinder were based on the pO_2 value measured in the blood. The data give evidence that the critical pO_2 level in cerebral tissues agrees well with the general picture of functional disturbances. Author

N68-13192# Joint Publications Research Service, Washington, D. C.

OF THE EFFECT OF ELIMINATION OF AFFERENT SIGNALIZATION ON THE TONIC FUNCTION OF SKELETAL MUSCLES

M. N. Murav'yev *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 95–102 refs (See N68-13181 04-04)

The motor activity of a frog and the functional state of a tonic specimen were studied over a three-month period after a unilateral deafferentation. This resulted in a disturbed motor coordination and a considerable decrease of the performance of the m. ileofibularis tonic apparatus of the deafferentated extremity. The muscle reactivity to acetyl choline increased immediately after the operation but became lower than usual by the 60th and 90th days after the operation. Changes of the excitability and functional lability of the tonic apparatus of the ileafibular muscle were less distinct after the tenotomy of nerve roots. Author

N68-13193# Joint Publications Research Service, Washington, D. C.

HISTOCHEMICAL STUDY OF TISSUE ENZYMES IN HYPOTHERMIA AND HYPOBIOSIS

V. V. Portugalov, I. B. Krasnov, Ye. I. Il'inakakuyeva, N. N. Timofeyev, and L. L. Marfina *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 103–108 refs (See N68-13181 04-04)

Histochemical methods were used in studying the effect of a two-hour period of hypothermia brought about under conditions of increasing hypercapnia–hypoxia and a 24-hour period of hypobiosis brought about using neuroplegic mixtures to affect the activity of oxidative enzymes involved in carbohydrate and fat metabolism, synthesis of nucleic acid precursors and enzymes responsible for electron transfer in the liver, kidney, heart and cellular formations of the somesthetic analyzer and macrocellular nuclei of the hypothalamic part of the rat brain. The specific metabolism of the nerve tissue was judged from the level of cholinesterase activity. Changes in the activity of the enzymes which developed under hypothermal and hypobiotic conditions are described and their probable functional significance is determined. Author

N68-13194# Joint Publications Research Service, Washington, D. C.

EFFECT OF HYPEROXIA ON FORMATION OF TOXIC LIPIDS IN RATS

F. V. Babchinskiy and I. N. Savateyev *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 109–113 refs (See N68-13181 04-04)

Experiments were carried out on white male rats exposed to different hyperoxic atmospheres for 20 days. The accumulation of toxic lipids in rat liver was determined by their hemolytic activity, evaluated using a method described earlier. In a 94–96% oxygen atmosphere at sea level pressure the hemolytic activity of the lipids experienced a small increase in 24 hours, followed by a high increase by the 48th and 60th hours of the experiment. In a nitrogen–oxygen mixture (70% O_2, 30% N_2) and in an oxygen atmosphere at a total pressure of 567 mm Hg (in both cases the partial oxygen pressure was 488 mm Hg) the hemolytic activity of the lipids increased by the 15th day. In the 50% O_2–50% N_2 atmosphere the hemolysis of erythrocytes remained unchanged throughout the experiment. It was concluded that an evaluation of the hemolytic activity of lipids may be used as a nonspecific indication of the oxygen toxic effect. An accumulation of toxic lipids is dependent on partial oxygen pressure and the duration of exposure. The partial oxygen pressure of 488 m Hg therefore may be regarded as a subtoxic value for a 20-day period of continuous exposure. Author

N68-13195# Joint Publications Research Service, Washington, D. C.

CHANGE OF THE PSYCHOPHYSIOLOGICAL STATE OF THE BODY BY AUTOGENOUS AND EXOGENOUS SUGGESTION

G. I. Gurvich, V. L. Marishchuk, M. I. Tishchenko, G. D. Yefimenko, and B. S. Khvoynov *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 114–118 refs (See N68-13181 04-04)

The objective of this study was an investigation of changes of the activity of organs and systems of the human body subjected to prolonged bed rest by autogenous or exogenous suggestion. Six test subjects underwent a 70-day bed rest. Three test subjects served as controls. The other three subjects were trained for the first two weeks on how to stress or relax different muscle groups with subsequent sleep suggestion. According to ECG and EEG recordings and myotonometric and actographic data sleep began in the seventh–fifteenth minute after the second–third week of the experiment. Beginning with the fifth week the test subjects engaged in autosuggestion, attaining similar results. Exogenous suggestion also was performed, employing a radio and a tape recorder. The procedure described provided sound refreshing sleep of the test subjects at the scheduled time. Author

N68-13196# Joint Publications Research Service, Washington, D. C.

MODELING OF PSYCHOPATHOLOGICAL SYNDROMES BY SPACE PSYCHOLOGY METHODS

O. N. Kuznetsov and V. I. Lebedev *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 119–125 refs (See N68-13181 04-04)

Psychic changes occurring during sensory deprivation and brief weightlessness are considered as models of some psychopathological syndromes. The hypothesis of their origin is demonstrated by a clinical analysis. Adaptation activity of the individual in an unusual environment is believed to play the leading role in the genesis of specific psychic changes. Criteria have been formulated on how to discriminate normal and pathological states when evaluating the mentioned psychic changes; these may be used in neuropsychiatric examinations. Author

N68-13199# Joint Publications Research Service, Washington, D. C.

EFFECT OF AN ELECTRICAL STIMULUS ON THE REACTION OF THE HUMAN VESTIBULAR APPARATUS CAUSED BY ACCELERATION

G. V. Voronin *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 142–152 refs (See N68-13181 04-04)

The purpose of this investigation was to establish the possibilities of an electrical control of human vestibular responses to accelerations. Experiments with a combined (adequate and electrical) effect on the vestibular apparatus of man indicated that: the vestibular reactions to accelerations can be increased or decreased by exposure of the surface of the head to an electrical current; electrical inhibition of vestibular reactions to accelerations can be brought about in two ways—blocking and compensation; a quantitative evaluation of the effect of a 7.5 mA current on the postnystagmus duration following rotation upon a stop-stimulus showed that the blocking effect of the current decreases the intensity and duration of vestibular responses to accelerations. Author

N68-13203# RAND Corp., Santa Monica, Calif.

COMMENTARIES ABOUT THE USE OF THE COMPUTER IN THE INVESTIGATION OF THE NERVOUS SYSTEM [COMENTARIOS ACERCA DEL USO DE LA COMPUTADORA EN LA INVESTIGACION DEL SISTEMA NERVIOSO]

Donald H. Perkel Dec. 1967 7 p In SPANISH Presented at the 8th Congr. of the Latin Am. Assoc. of Physiol. Sci., Mexico, 11–15 Aug. 1967 Sponsored in part by the AF

(Grant PHS-NB-07325)

(P-3659; AD-662006)

The discussion covers four applications of the computer in the investigation of the nervous system. In the first, the computer is used as a calculating machine to make the computations needed during (real time) or after a neurophysiological experiment. In the second application, the computer performs a controlling role, for example, when the presence or the intensity of a response determines the selection of the following stimulus. The third mode consists of using the computer as a simulator to create models or representations of certain aspects of a nervous system function such as a neural net. Finally, the computer has a theoretical application in the ideas of communication and control which constitute the science of cybernetics. Because comparisons are often made between the computer and the brain in which the former is referred to as an "electronic brain," the essential differences between the two are explained. Transl. by R.N.A.

N68-13207*# Research Triangle Inst., Durham, N. C. Engineering and Environmental Science Div.

BIOMEDICAL APPLICATIONS TEAM Quarterly Progress Report, 15 Sep.–14 Dec. 1967

14 Dec. 1967 26 p

(Contract NSR-34-004-045)

(NASA-CR-91387; EU-349; QPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 06C

An overview is presented on the effort of the applications team to match problems that medical and clinical researchers may have with NASA technology results that may provide solutions. Personal contacts with the medical school consultants are discussed in relation to proposed programs which may offer opportunities for technology transfer. Specific examples are included of problem abstracts which accurately define the specific problem in engineering terminology, and which are prepared after comprehensive discussions with the individual researchers. M.G.J.

N68-13304*# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Advanced Research Lab.

RADIATION PROTECTION BY AUXIN ANALOGUES AND ANTIVIRAL AGENTS

D. Norman, R. D. Schultz, and C. W. Steers Jun. 1968 19 p refs Sponsored in part by NASA

(Contract PH-43-64-865)

(NASA-CR-91340; Douglas Paper-4079) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Although plant growth modifiers were found to be totally devoid of radiation-protective activity, their structural analogues were found to protect male Webster white Swiss mice against lethal doses of ^{60}Co γ-radiation. A broad-spectrum antiviral agent, statolon, which alone exhibited no activity, was found to synergize the protective action of certain growth modifying analogs. The possibility of latent virus involvement in radiation damage in a manner similar to bacterial lysogeny is also discussed. Author

N68-13316*# Drexel Inst. of Tech., Philadelphia, Pa. Dept. of Chemistry.

MECHANISMS FOR THE EFFECTS OF ELECTRIC AND MAGNETIC FIELDS ON BIOLOGICAL SYSTEMS Semiannual Status Report, Jun.–Dec. 1967

S. Kusabayashi, T. M. Laronge, and M. M. Labes Dec. 1967 10 p refs
(Grant NGR-39-004-015)
(NASA-CR-91523; SASR-1) CFSTI: HC $3.00/MF $0.65 CSCL 06F

Molecular level explanations are considered for the influence of weak electrical and magnetic fields on biological systems. A liquid crystalline phase is being used as a model for the biological organelles. To examine the response of the transport properties of liquid crystalline materials to modest magnetic fields, studies are being made of the charge carrier transport, viscosity, and diffusion in liquid crystals. M.W.R.

N68-13432*# Israel Program for Scientific Translations, Ltd., Jerusalem.
BIOCHEMISTRY OF THE NERVOUS SYSTEM
A. V. Palladin 1967 136 p refs Transl. into ENGLISH of the publ. "Voprosy Biokhimii Nervnoi Sistemy" Kiev, Izd. Naukova Dumka, 1965 Publ. for NASA and NSF
(NASA-TT-F-439; TT-67-51375) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Metabolism of the brain in various functional states, problems related to biochemistry of the brain and nervous system, and the use of radioactive isotopes for biochemical studies of the nervous system are discussed in reprints of conference papers. Other papers deal with the nervous system of hibernating animals, activity and localization of various subcellular cerebral functions separable by electrophoresis in agar gels, and the use of neurotropic drugs. M.W.R.

N68-13475# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
NEUROPHYSIOLOGY
W. S. McCulloch, J. Y. Lettvin, P. D. Wall, M. Blum, J. E. Brown et al *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 191–229 refs (See N68-13461 04-23)
(Contract NSR-22-009-138; Grant NIH-5-R01-NB-04985-04)

The state transition matrix is used to analyze shift register netowrks regarded as a neural net of N neurons and M external inputs and defined by a set of N Boolean equations. The network corresponds thus to a shift register of N delay elements, which is linear or nonlinear, depending upon the nature of the Boolean function of external inputs and outputs. Also formulated is a psychophysiological sensory receptor model that uses the Mach band mechanism to yield an output from which the conversion of color to colored things can be derived. G.G.

N68-13491# Technische Hochschule Munchen (West Germany).
EASILY SEPARATED PROTECTIVE GROUPS FOR AMIDO ACID FUNCTIONS [LEICHT ABSPALTBARE SCHUTZGRUPPEN FUER SAEUREAMIDFUNKTIONEN]
Jonas Bjarnason (Ph.D. Thesis) [1967] 99 p refs In GERMAN

Various N-substituted benzamides were prepared. Using a new type of C-N dissociation, it was possible in many instances to separate the *N*-substituents with trifluor acetic acid. The reversibility of the dissociation was proven for N-benzhydryl amides. Of the residuals that were examined, the 2,4 dimethoxybenzyl group appears to be best suited for protection of the amino acid amides. Kinetic studies of the DMB dissociation with trifluor acetic acid on several glycine DMB amide derivatives and on N-TFA-DL-met-NH-DMB showed that the separation of the DMB residue is retarded by a free amino or thioether group in the molecule. Several N,N-bis-DMB amide derivatives of asparagine and glutamine were prepared. The compound Z-gly-L-(N-DMB)phe-OH was prepared and condensed to a tripeptide using L-val-OtBu. Peptide derivatives protected by the DMB residue are clearly better soluble in organic solvents than unprotected compounds. Transl. by K.W.

N68-13552# Cornell Univ., Ithaca, N. Y.
THE RELATION OF PROTEIN STRUCTURE TO THE CATALYTIC PROPERTIES OF ENZYMES Final Report, 1 May 1958–30 Sep. 1967
George P. Hess 30 Sep. 1967 14 p refs
(Contract Nonr-401(35)
(AD-661450)

Investigations of structural and functional relationships in reactions catalyzed by enzymes, mainly the hydrolytic enzyme chymotrypsin, were carried out through elucidation of individual reaction steps. This was done by characterizing and measuring physical and chemical changes in the enzyme which accompany the reactions under various conditions of pH and temperature and with various substrates and by making kinetic studies of these physical changes. This approach yields information not obtainable with the usual steady state approach, which may yield only combinations of rate and equilibrium constants. Results obtained in these experiments with enzyme in solution correlate well with independent x-ray diffraction studies of crystalline chymotrypsin by Blow and coworkers, and indications are that the approach and methods developed and used in this project, in conjunction with future x-ray diffraction experiments on crystalline materials, can provide detailed information needed for an understanding of the specificity and efficiency of reactions catalyzed by chymotrypsin and other hydrolytic enzymes. The work done so far has led to the development of an hypothesis concerning the conversion of chymotrypsinogen to chymotrypsin, a resulting pH-dependent equilibrium between enzyme conformations and the binding of substrate to enzyme. Other results obtained include the measurement by flow and relaxation techniques, of six rate constants (five not previously determined) pertaining to intermediates in chymotrypsin-catalyzed reactions. Author (TAB)

N68-13711# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
APPLICATIONS OF THERMOLUMINESCENCE DOSIMETRY IN HEALTH PHYSICS
J. Cluchet and H. Joffre *In* NRL Luminescence Dosimetry Apr. 1967 p 349–358 refs (See N68-13681 04-14)

The physical problems of photon dosimetry for the exact evaluation of the biological risks for any energy between 10 keV and 10 MeV are discussed, and the conditions that must be satisfied by the detecting medium and the materials in contact with it (e.g., outside wall) are derived. Applied to thermoluminescence dosimetry, the principles defined lead to a choice of compounds of low atomic number (LiF and $Li_2B_4O_7$) for detecting mediums. It is also necessary to study carefully the thickness and the composition of the walls and materials making up the dosimeter. Author

N68-13714# Hammersmith Hospital, London (England).
EXIT DOSES FOR LUNG AND PHARYNX TREATMENT FIELDS MEASURED BY LITHIUM FLUORIDE THERMOLUMINESCENCE
Vesna Svarcer, J. F. Fowler, T. J. Deeley, and E. Shuttleworth *In* NRL Luminescence Dosimetry Apr. 1967 p 372–379 refs (See N68-13681 04-14)

Lithium fluoride thermoluminescence dosimetry powder was used in capsules to measure the exit doses in patients having treatment to the thorax with 8-MV X-rays. Exit doses for fields passing through lungs were up to 60% higher than doses calculated on the assumption of homogeneous-density tissue. The dose received at the tumor would thus be increased by approximately half this percentage. Such increases could be satisfactorily explained because the X-rays passed through air-containing lung tissue. Where growth, fluid, or fibrosis was present in the lung, the discrepancy was smaller. In cases where the exit dose was lower than expected, the central rays had passed through the spine. In most of the

cases, it was possible to explain the observed exit dose after the measurement was made. However, the variation from patient to patient was extremely large, and this could not have been assessed from radiographs or clinical examination. It is therefore not possible to apply general correction factors, and either the exit dose must be measured on each patient, or special techniques of tomography must be employed, if accurately known doses are required. The results of placing an array of LiF capsules on the exit side of air-containing pharynx fields are also presented. Author (NSA)

N68-13715# Texas Univ., Houston.

USE OF LITHIUM FLUORIDE DOSIMETERS FOR IN VIVO MEASUREMENT OF TRANSMISSION THROUGH BONE AND LUNG

E. H. Crosby, M. L. M. Boone, P. R. Almond, B. R. Worsnop, M. C. McGoodwin et al *In* NRL Luminescence Dosimetry Apr. 1967 p 380–392 refs (See N68-13681 04-14)
(Grant PHS-CA-06294)

A study of the physical characteristics of LiF dosimeters has been carried out. Under optimum conditions (irradiation with ^{137}Cs γ rays), the reproducibility of response was $\pm 1\%$. For normal laboratory exposures producing doses in the range 50 to 300 rads, the reproducibility was $\pm 2\%$ to $\pm 5\%$. A study of the decay of thermoluminescence after irradiation showed an initial decay of about 10% during the first 24 hr and then a steady decay of another 4% in 50 days. A marked decrease in response of about 10% as compared to ^{60}Co γ rays has been noticed at high energies with the use of 6 to 18-MeV electrons and 22-MeVp X-rays. The dosimeters have been used for a series of dose intercomparisons between different laboratories. Agreement between preirradiatad controls which stayed in Houston and those which went to the other institutions was $\leq 1\%$. The effects on depth dose of nontissue-equivalent materials such as bone and lung have been studied by in vivo measurements in dogs and patients for high-energy electron beams. Author

N68-13716# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

IN VIVO THERMOLUMINESCENCE DOSIMETRY OF GAMMA RAYS FROM INGESTED CESIUM-137 IN SHEEP

C. R. Watson and R. O. McClellan *In* NRL Luminescence Dosimetry Apr. 1967 p 393–401 refs (See N68-13681 04-14)
(Contracts AT(45-1)-1350; AT(45-1)-1830)

Dosimetry of internally deposited γ-ray emitters is complicated by nonuniform distribution of the radionuclide and transient irradiation from nonabsorbed radionuclide in the gastrointestinal tract. The LiF thermoluminescence dosimetry (TLD) was used to measure γ-ray doses in vivo in male sheep ingesting ^{137}Cs. Two commercial TLD systems were found satisfactory for measurements of 500 to 800 mR after a nitrogen purge of the readout chamber was added. Specially fabricated Teflon capsules (4 mm wall thickness) shielded the LiF from the β radiation of ^{137}Cs without appreciably attenuating the γ radiation. Dosimeters were surgically implanted and exposed in vivo for 15 days to measure γ-ray dose rates of 20 to 60 mrad/day (total dose, less than 1 rad) in sheep with body burdens of approximately 300 μCi of ^{137}Cs. Dosimeters were implanted in another group of sheep prior to the feeding of 50 μCi of ^{137}Cs per day. These animals were killed at intervals to study the accumulation of γ-ray dose at various organs during the month of ^{137}Cs feeding. Tissue acceptance of the dosimeters was excellent, and dose distribution patterns were similar to those reported earlier. These measurements support the National Committee on Radiation Protection recommendations that assume that designation of the whole body as the critical organ will adequately consider the dose to the gonads in the case of a relatively uniformly distributed γ-ray-emitting radionuclide. Author (NSA)

N68-13718# California Univ., Los Angeles. Dept. of Radiological Sciences.

APPLICATION OF LITHIUM FLUORIDE (TLD-100) TO TISSUE-DOSE MEASUREMENTS IN HIGH-ENERGY CHARGED-PARTICLE BEAMS

C. A. Sondhaus, J. K. Ashikawa (Univ. of Southern Calif., Los Angeles), L. K. Kleppe (Calif. Univ., Berkeley, Lawrence Radiation Lab.), F. W. Miller, H. W. Patterson et al *In* NRL Luminescence Dosimetry Apr. 1967 p 412–417 refs (See N68-13681 04-14)

A LiF thermoluminescent dosimetry system was built which is capable of accurately measuring γ-ray exposures from 10 mR to more than 30,000 R. Response curves were obtained for γ radiation from ^{60}Co and radium X-rays of 100 and 250 kVp, high-energy protons and α particles, and both 5-MeV and thermal neutrons. The problems of reducing variations in the PM-tube dark-current magnitude and increasing the overall stability of the system were solved by use of an infrared filter, by standardization of the operating procedure, and by cooling of the face of the PM tube with room-temperature dry-nitrogen gas. This LiF dosimetry system is currently being used in a variety of biomedical applications, among which are cancer research and space medicine. Other applications include determining the field pattern of X-ray machines and, in the future, personnel monitoring. The system has also been used to study shock- and strain-induced thermoluminescence in limestone. Author (NSA)

N68-13772* Chicago Univ., Ill. Dept. of Biophysics.

INTEGRATED RESEARCH AND TRAINING IN SPACE-MOLECULAR BIOLOGY Annual Progress Report, 1 Jan.–31 Dec. 1967

Humberto Fernandez-Moran 31 Dec. 1967 84 p
(Grant NsG-441-63)
(NASA-CR-91527) CFSTI: $3.00 CSCL 06C

Refinements in the electron microscope, improvements in laboratory techniques, and research at the microbiological level are raported. Specific developments are described in the methodology for collecting and identifying extraterrestrial particles, preparation techniques, and superconducting cryo-electron microscopy. Research activity, illustrated with electron photographs with resolutions of 4–15 Å, is discussed in the following areas: membrane organization, and particularly nerve membrane systems; DNA conformations associated with membranes in chloroplasts; nerve myelin sheath and frog retinal rod outer segments; hemagglutinin isolated from *Limulus polyphemus*; and the binding of RNA polymerase to different types of DNA. N.E.N.

N68-13773*# George Washington Univ., Washington, D. C. Biological Sciences Communication Project.

SCIENTIFIC COMMUNICATION RESEARCH IN SPACE BIOLOGY Annual Progress Report, 1 Jan.–31 Dec. 1967

29 Dec. 1967 163 p refs
(Contract NSR-09-010-027)
(NASA-CR-91507) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Bibliographies on planetary quarntine are presented, and research activities in exobiology are briefly reviewed. The bibliographies are divided into the areas of policy, environmental microbiology, and engineering parameters. N.E.N.

N68-13776* California Univ., Berkeley. Dept. of Nutritional Sciences.

CLINICAL NUTRITIONAL STUDY OF MINIMUM PROTEIN AND CALORIC REQUIREMENTS FOR MAN Annual Report, Sep. 1965–Sep. 1966

Sheldon Margen and Doris Howes Calloway Sep. 1966 77 p refs
(Grant NGR-05-003-068)
(NASA-CR-91287) CFSTI: $3.00 CSCL 06A

Systems proposed for regeneration of cabin atmosphere in prolonged space flight and planetary stations are most effective when they serve a dual role, as sources of both oxygen and food. Presently conceived chemical systems produce in high yield only carbohydrates or carbohydrate-like substances and require that supplies of protein or amino acids be stored or regenerated by a second, complementary system. Thus, a first limitation of these schemes would appear to be the minimum amount of protein that must be provided. On the other hand, in systems involving a biological agent as the regenerator, high growth rate of the agent is required and the cellular product thus includes high concentrations of protein and of genetic material, nucleic acids. These systems might require supplementation with additional non-protein energy sources if the protein yield exceeds man's tolerance for this nutrient form. If a supplementary energy source were to be carried, fat would be the more desirable form because it yields more calories per unit weight and volume than does carbohydrate. Author

N68-13781 Atomic Energy Commission, Washington, D. C. Technical Information Div.

RADIATION TRANSPORT AND BIOLOGICAL EFFECTS

D. K. Trubey, ed. [1966] 107 p refs Presented at the Am. Nucl. Soc. Meeting, Pittsburgh, 1 Nov. 1966
(ANS-SD-4; CONF-661125, Sup. 1) CFSTI: $3.00

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N68-13782 Oak Ridge National Lab., Tenn. Radiation Shielding Information Center.

RADIATION TRANSPORT AND BIOLOGICAL EFFECTS

D. K. Trubey *In* AEC Radiation Transport and Biol. Effects [1966] p 3–10 (See N68-13781 04-04)

Problems of establishing radiation protection criteria are summarized, along with a review of papers presented on radiation transport calculations or the interpretation of biological effects. Criteria for radiation criteria are discussed in terms of permissible dose to critical organs and fast neutron dose weighting factors for man-rated SNAP reactors. In reviewing this session oriented toward biological shielding, the need for continued research on the physical and biological parameters in radiation environments is stressed. M.W.R.

N68-13783 Atomic Energy Commission, Washington, D. C. Technical Information Div.

CRITERIA FOR RADIATION PROTECTION: PERMISSIBLE DOSE TO CRITICAL ORGANS

Harald H. Rossi *In its* Radiation Transport and Biol. Effects [1966] p 13–17 (See N68-13781 04-04)

A careful and conservative attitude is stressed in relation to selection of maximum permissible doses for radiation exposure. Major biophysical variables influencing radiation effects and major late effects of chronic irradiation are noted, and basic limits are given for both occupational and nonoccupational exposure. M.W.R.

N68-13784 Atomic Energy Commission, Washington, D. C. Technical Information Div.

FAST NEUTRON DOSE WEIGHTING FACTORS FOR MANRATED SNAP REACTORS

G. W. Spangler and C. A. Willis *In its* Radiation Transport and Biol. Effects [1966] p 21–23 (See N68-13781 04-04)

Radiation protection considerations during space flight are discussed; and, while it is noted that several unusual considerations accompany the use of space reactors, only minimal safety margins are required. An appropriate basis for the choice of fast neutron dose weighting factors is not readily apparent, and the relationship between biological effects and the weighting factor is, therefore, considered. Additional studies are required to determine radiation effects in space, particularly the hazards due to radiative additivity from different sources. Mention is made of reduction of shielding weights for SNAP reactors. M.W.R.

N68-13785 Atomic Energy Commission, Washington, D. C.

DISTRIBUTION OF DOSE AND DOSE EQUIVALENT IN AN ANTHROPOMORPHIC PHANTOM RESULTING FROM BROAD-BEAM SOURCES OF MONOENERGETIC NEUTRONS

W. S. Snyder, J. A. Auxier, M. D. Brown, T. D. Jones, and R. T. Boughner *In its* Radiation Transport and Biol. Effects [1966] p 27–45 refs (See N68-13781 04-04)

A Monte Carlo-type program was coded for a digital computer to estimate dose in a tissue phantom from a variety of neutron sources with neutron energy not exceeding 14 meV. The program allows for elastic and inelastic scattering as well as for some 14 absorption interactions. The phantom, consisting of a right circular cylinder with a radius of 15 cm and a height of 60 cm, is a reasonable approximation of a human torso. It is considered to be homogeneous and composed of H, C, N, and O in the proportions indicated for man. With some rewriting of the source subroutine, the program may be used for a wide variety of sources, but only results for a monodirectional, monoenergetic, broad, lateral beam of neutrons are reported here. Author

N68-13786 Atomic Energy Commission, Washington, D. C. Technical Information Div.

ON DEPTH-DOSE CALCULATIONS IN AN EVALUATION OF FALLOUT SIMULATORS AND FALLOUT FIELDS

C. W. Garrett and R. L. French *In its* Radiation Transport and Biol. Effects [1966] p 51–56 ref (See N68-13781 04-04)

Several real and simulated fallout situations were studied, and Monte Carlo simulations indicate that dose distributions for actual fallout and compact simulators are very similar. For fallout field models, radial distributions are relatively flat. Comparison of three geometries illustrates how depth dose calculations aid in evaluating the effectiveness of a simulator, even though there are differences in photon spectra. Distributions for a phantom placed in a foxhole are compared with above-ground fallout field dose patterns; and while the radial distributions are similar, the axial distributions are completely different. M.W.R.

N68-13787 Atomic Energy Commission, Washington, D. C. Technical Information Div.

A NEW TECHNIQUE FOR THE COMPUTER REPRESENTATION OF THE HUMAN BODY

Phillip S. Mittelman and Walter Guber *In its* Radiation Transport and Biol. Effects [1966] p 59–65 (See N68-13781 04-04)

A geometrical description technique is presented that can be used for the computer representation of the human body. A computer-produced description of the heart is presented, as is a simple body model built from an elliptical cylinder, ellipsoids, and a wedge. The technique requires a minimum of a computer memory and has simplified geometric input. Rapid tracking of radiation through the configuration is possible, and dosage calculations can be made with great accuracy by using the body description technique with the UNC-SAM II Monte Carlo program. M.W.R.

N68-13788 Atomic Energy Commission, Washington, D. C. Technical Information Div.

PHYSICAL AND BIOLOGICAL DOSE CALCULATIONS FOR PROTON AND ALPHA FLUXES INCIDENT ON A SHIELDED MAN MODEL

C. W. Hall, K. M. Simpson, Jr., and W. B. Ritchie *In its* Radiation Transport and Biol. Effects [1966] p 69–78 (See N68-13781 04-04)

A sphere, two cylinders, and a reasonable facsimile of the human body were used as models for the calculation of proton and alpha incident fluxes on a shielded man. The influence of performing transport calculations on doses to specific organs is investigated and a thin shield is used. The phantoms yield very similar results except in the case of widely distributed BFO's. It is concluded that spherical man models may be used to estimate dose to skin, eyes, midline, and possibly blood-forming organs in parametric studies with fairly uniform shields. More detailed phantoms will be needed for nonuniform shielding. M.W.R.

N68-13789 Atomic Energy Commission, Washington, D. C. Technical Information Div.

DOSE AND DOSE-EFFECT RELATIONSHIP MODIFYING FACTORS IN PREDICTING THE DEGREE OF BIOLOGICAL RESPONSE

V. P. Bond *In its* Radiation Transport and Biol. Effects [1966] p 81 (See N68-13781 04-04)

It is noted that the dependence of biological effect on dose rate is slight in the case of accidental massive radiation doses that occur over a period of seconds to hours, and that the RBE for high-LET radiations usually encountered is close to unity for the bone marrow syndrome. The degree of inhomogeneity of dose distribution on a macro scale is considered to be the chief modifying factor for use in determining the early effects of massive exposure, and it is with exposure over months to years that dose rate becomes a major factor. Although the mean dose is not particularly useful in predicting early mortality, it may be of use in predicting cancer induction. M.W.R.

N68-13790 Atomic Energy Commission, Washington, D. C. Technical Information Div.

RADIATION RESPONSES OF MAN IN THE INTERMEDIATE DOSAGE RANGE

Wright H. Langham *In its* Radiation Transport and Biol. Effects [1966] p 85–89 (See N68-13781 04-04)

Early and late somatic effects to intermediate radiation dosages are described. This discussion of dose-response relationships in man is based on exposures to penetrating X-rays or gamma rays; and is subject to modification factors such as radiation quality, dose protraction, nonhomogeneities in dose distribution, and variations in the population receiving the dosages. Skin erythema and desquamation, prodromal response, hematological depression, decreased fertility and actual sterility, and early lethality are noted as the early effects; while the later or delayed effects are permanent or delayed skin changes, increased incidence of cataracts as well as of leukemia and other neoplastic diseases, and general life shortening. Genetic effects are not referenced in this summary report. M.W.R.

N68-13791 Atomic Energy Commission, Washington, D. C. Technical Information Div.

CELLULAR AND MAMMALIAN RADIATION EFFECTS AND THEIR INTERPRETATION IN RELATION TO MANNED SPACE FLIGHT

Paul Todd *In its* Radiation Transport and Biol. Effects [1966] p 93–95 (See N68-13781 04-04)

Various factors which modify the effects of ionizing radiation on human reproductive organs are discussed, and the effects of radiation on biological response to environmental agents as well as the effect of these agents on radiation response are summarized. Modification of radiation effects have been ameleiorated by removal of oxygen, cysteamine protection, and dosage spacing and dosage reduction. Prior irradiation results in occasional debilitated cells which produce radiation-sensitive progeny that are eventually outgrown by normal surviving cells. Ultrasonically irradiated cells increase chromosome breakage and reduce survival, and chromosome deletions produced by beta radiation are produced at a greater frequency in the gravity-free state. Particulate radiations with a higher rate of energy loss inactivate cells more effectively, although particulate radiations do not appear to be different from X-rays in their dependence upon atomic number of the material surrounding the cells. Environmental agents considered in relation to responses are acceleration, cold, excitement, exercise, heat, radiation, vibration, and weightlessness. M.W.R.

N68-13792 California Univ., Berkeley. Lawrence Radiation Lab.

ENERGY-LOSS DISTRIBUTIONS AND FRACTIONAL CELL LETHALITY

Stanley B. Curtis *In* AEC Radiation Transport and Biol. Effects [1966] p 97–115 refs (See N68-13781 04-04)
(UCRL-17283)

Inactivation cross sections are suggested for quantifying biological effects such as energy loss distribution and fractional cell lethality caused by radiation exposure. These cross sections, discussed in relation to particle energy loss, are analagous to nuclear reaction cross sections because they represent the probability for unit flux density of the proliferative capacity of the cell being destroyed. Such an approach may be of value in determining accumulated damage over a long period of time, such as would occur during extended space flights. In terms of the ratio of inactivation hits/cells of heavy components to protons, results indicate that the Fe–Ni ions cause about one and half times as much damage as protons under 0.2 g/cm^2 shielding from galactic cosmic radiation. For solar particle events, the He ion contributed slightly less than the protons, and the heavier components contributed less than the He ions. Increasing shielding causes a further drop in heavier component effects. Results also indicate that,

during large-particle solar events, up to 7% of the cells of a seated astronaut would have been inactivated 4 cm inside the body at the waist behind 1 g/cm^2 vehicular shielding. M.W.R.

N68-13840*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
ORBITING EXPERIMENT FOR STUDY OF EXTENDED WEIGHTLESSNESS Final Report
J. M. Smith and J. A. Dippel 13 Jan. 1968 619 p refs
(Contract NAS1-6972)
(NASA-CR-66520) CFSTI: HC$3.00/MF$0.65 CSCL 06S

Studied were preliminary design, mission, and development of a system for orbiting two 13-lb female Rhesus monkeys for a period of six months to one year to determine the psychological and physiological effects of extended weightlessness. The spacecraft is to be placed in orbit by a vehicle of the Apollo Application Program (AAP). Recovery is to be effected by the command module of a subsequent AAP flight. AAP Cluster B mission profiles were found to be compatible with the objectives. Flight 216 was selected as the launch vehicle and Flight 221 as the retrieving mission. A reliability assessment and tradeoff analyses were conducted. The design includes a thermal and atmosphere control subsystem, a waste management subsystem, a retrieval subsystem, a radiation—mass measurement subsystem, a data management subsystem, a solar cell electric power subsystem, and a sun-seeking attitude control subsystem. The mission analysis included prelaunch, launch, on-orbit, and recovery operations. Also considered were the steps, time spans, facilities, and equipment required for the program. It is concluded that the objectives are achievable with existing technology and that the desired flight date of mid-1970 can be met. K.W.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-12810# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE EFFECTS OF TASK-INDUCED STRESS ON SPEECH Final Report, Jul. 1, 1966–Jun. 30, 1967
Michael H. L. Hecker, Kenneth N. Stevens, Gottfried von Bismarck, and Carl E. Williams 25 Aug. 1967 81 p refs
(Contract AF 19(628)-6052)
(BBN-1542; AFCRL-67-0499; AD-660595)

In order to induce stress in an experimental subject, a task involving the addition of numbers under time pressure was developed. The subject was required to read six meters and to announce the sum of his readings, together with a test word. By controlling the duration of the meter display, the experimeter could vary the level of stress induced in the subject. For each of ten subjects, numerous verbal responses were obtained while the subject was under stress and while he was relaxed. Contrasting responses containing the same test word were assembled into paired-comparison listening tests. Listeners could identify the stressful responses of some subjects with better than 90 percent accuracy and of others only at chance level. The test words from contrasting responses were analyzed with respect to level and fundamental frequency, and spectrograms of these test words were examined. The results indicate that stress can produce a number of characteristic changes in the acoustic speech signal. Most of these changes are attributable to modifications in the amplitude, frequency, and detailed waveform of the glottal pulses. Other changes result from differences in articulation. Although the manifestations of stress varied considerably from subject to subject, the test words of most subjects exhibited some consistent effects. Author (TAB)

N68-12873# International Atomic Energy Agency, Vienna (Austria).
BASIC SAFETY STANDARDS FOR RADIATION PROTECTION
1967 89 p *Its* Safety Ser. No. 9

Safety standards are presented to provide a regulatory basis for protecting the health and safety of employees and the public, without imposing undue burdens upon users of radioactive material. These standards apply to the production, processing, handling, use, storage, transport, and disposal of natural and artificially produced radioactive material, and to the use and operation of other radiation sources. The data presented pertain to limitation of doses for exposures from controllable sources, radiation doses and intakes of radioactive materials through external and internal exposure, and fundamental operational principles to ensure radiation protection. Tables list the maximum permissible annual intakes in air or water for single radionuclides applicable to workers engaged in radiation work, and the maximum permissible activity for exemption from notification, registration, or licensing. M.G.J.

N68-13024# Applied Psychological Services, Wayne, Pa.
DIMENSIONS OF VISUAL INFORMATION DISPLAYS
Arthur I. Siegel and M. A. Fischl Sep. 1967 64 p refs
(Contract N00014-66-C-0183)

The study sought to determine the nature and composition of the display-observer interface. Twelve air defense command and control visual information displays, representing all combinations of three densities of air threat, two different primary formats, and two conditions of information coding, were exposed to subject groups of three different degrees of experience and familiarity with the displays and the tactical concepts involved in their use. Independent multidimensional scaling analyses were performed on the data derived from each subject group. Seven fundamental dimensions, which were congruent across the subject groups, were derived. The patterns of factor loadings suggested interpretations along the lines of: (1) stimulus numerosity, (2) primary coding, (3) contextual discrimination, (4) structure scanning, (5) critical relationships, (6) cue integration, and (7) cognitive processing. These are consolidated into a model, which may serve as a basis for understanding the display-observer interface. Author (TAB)

N68-13091# Explosives Research and Development Establishment, Waltham Abbey (England).
AN INVESTIGATION OF THE FUMES EVOLVED INSIDE VEHICLES DURING ENVIRONMENTAL TESTING
A. Davis and J. H. Golden 4 Aug. 1967 13 p
(ERDE-9/R/67; AD-661504)

The nature of the fumes evolved inside vehicles during environmental testing at 71C (160F) for 3 days was examined. Ten components were identified and one, formaldehyde, was quantitatively estimated. The concentration of formaldehyde was considerably in excess of the toxic limit but it is not known whether or not the other components exceeded their specific toxic limits. An investigation of the various individual plastics used in the vehicle during heating showed that the reinforced resins (phenol/formaldehyde, melamine/formaldehyde, polyester/styrene and silicone) gave rise to significant quantities of volatile materials of two major types, unused reactants and various organic solvents used during preparation. Methods for elimination of the fumes are briefly considered. Author (TAB)

N68-13149* Harvard School of Public Health, Boston, Mass. Guggenheim Center for Aerospace Health and Safety.

HUMAN PERFORMANCE IN ADVERSE ENVIRONMENTS Final Report

Ross A. McFarland, Norman H. Mackworth, and Warren H. Teichner 1 Nov. 1967 35 p refs

(Grant NsG-718)

(NASA-CR-91444) CFSTI: $3.00 CSCL 06S

Three areas in the field of visual perception have been studied in relation to human performance in adverse environments. The first major area of research was concerned with the relationship of central and peripheral vision while carrying out selected tasks. The second major area dealt with prolonged attention and visual search, in relation to the performance of selected tasks. These experiments were carried out while subjects were exposed to simulated altitudes and other stressful situations. The third area dealt with pattern recognition and target detection. Emphasis was placed on the development of new techniques and equipment for the measurements of performance under altered environments and stresses. Special attention was given to the improvement and use of a stand eye camera and a head-mounted eye camera for studies involving visual search. A new reflex eye camera has been designed for this purpose and a new apparatus was built for the measurement of prolonged visual search, attention, and task performance. Author

N68-13172* General Electric Co., Philadelphia, Pa. Missile and Space Div.

A RESEARCH STUDY TO DEFINITIZE A BIO-ISOLATOR SUIT SYSTEM Final Report

A. A. Glass 15 Dec. 1967 89 p

(Contract NAS1-6537)

(NASA-CR-66441-A; GE-67SD2047) CFSTI: $3.00 CSCL 06K

An instruction manual is provided for the installation, operation, maintenance, and repair of the bio-isolator suit system (BISS) life support system console and supporting communication links. The BISS console monitors and controls air temperature, humidity, and volume passed to and from the isolation suit. The communication system provides for two way links between the test conductor console (TCC) and the BISS suit, and between the TCC, the life support system console, and the medical monitor unit; a horn warning system; and monitoring of communications between the TCC and the BISS suit at the life support console and the medical monitoring unit. The nomenclature and function of all operating controls and indicators are defined. Power requirements are specified and required test equipment is listed. Probable causes of, and corrective procedures for, malfunctions are tabulated. Schematic drawings are presented for circuitry and panel designs. E.J.S.

N68-13185# Joint Publications Research Service, Washington, D. C.

GAS EXCHANGE BETWEEN MAN AND A CULTURE OF MICROALGAE IN A 30-DAY EXPERIMENT

L. V. Kirenskiy, I. A. Terskov, I. I. Gitel'zon, G. M. Lisovskiy, B. G. Kovrov et al *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 32–40 (See N68-13181 04-04)

The biological regeneration of an enclosed atmosphere based on the use of algal photosynthesis has been performed. A 30-day experiment has demonstrated that man and unicellular algae (Chlorella vulgaris) are biologically compatible and their gaseous metabolites produce no toxic effect on either component. The discrepancy between the assimilation coefficient of algae and the respiration coefficient of man can be eliminated by corrections of the diet offered to test subjects, remaining within the physiological optimum. Author

N68-13188# Joint Publications Research Service, Washington, D. C.

METHODS FOR EXPERIMENTAL STUDIES OF THE REFLEX INTERACTION OF ANALYZER SYSTEMS

Z. Novotny *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 53–59 refs (See N68-13181 04-04)

The author describes the methods and instruments used in study of the effect of different analyzer systems on the change of human posture and spatial position. The apparatus, an unstable platform, is based in part on the "rocking chair" designed by Soviet specialists and in part on a device used by Chodera in investigating the conditioned falling reflex. In some cases the apparatus can simulate horizontal plane flight. Author

N68-13197# Joint Publications Research Service, Washington, D. C.

A METHOD FOR USING AN ELECTRONIC COMPUTER FOR DETERMINING SOME MOTION CHARACTERISTICS IN BIOMECHANICAL INVESTIGATIONS

B. A. Dushkov, V. P. Produnov, and S. A. Kosilov *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 126–134 refs (See N68-13181 04-04)

An algorithm has been formulated for determining the basic parameters of human movements by use of an electronic computer. The algorithm makes possible a considerable reduction of the time spent in computations and a speedup in obtaining final biomechanical information. Author

N68-13198# Joint Publications Research Service, Washington, D. C.

COORDINATION STRUCTURE AND RECONSTRUCTION PHASES OF MOTOR HABITS UNDER CONDITIONS OF WEIGHTLESSNESS AND ACCELERATIONS

I. F. Chekirda *In its* Space Biol. and Med., Vol. 1, No. 4 19 Dec. 1967 p 135–141 refs (See N68-13181 04-04)

The author has made an analysis of the coordination structure of some movements of man subjected to weightlessness and accelerations during jet flight along a Keplerian trajectory. A relationship was established between the coordination structure of movements and the field of force. Different phases in the reconstruction of movements in a state of weightlessness were defined. It is recommended that cyclogrammometric techniques be used in studying movements as tests for selection and training of cosmonauts for orbital flights. Author

N68-13200# Sperry Rand Research Center, Sudbury, Mass.

CONTOUR DESCRIPTOR PROPERTIES OF VISUAL SHAPE Final Report, 1 Feb. 1966–31 Jan. 1967

L. Kaufman et al Sep. 1967 90 p refs

(Contract AF 19(628)-5830)

(SRRC-CR-67-43; AFCRL-67-0525; AD-662005)

The results of a one year program to elucidate the problems underlying shape perception are presented. Following a review of the field, extensive studies of spontaneous fixation tendencies in visual forms are reported. These studies indicate that visual shape is a stimulus to fixation, suggesting that the peripheral inputs, per se, are not the primary determiners of spontaneous fixation tendencies, but that the already organized cortical representation of shape is such a factor. Experiments with flow patterns in visual noise suggest that the visual system does behave as if it has field or global properties. Finally, studies of illusions indicate that a second class of visual illusions can be designated on the basis of dependency on converging lines or line segments as the inducing feature. Illusions in this inclination-dependent class are all such that if the illusion inducing lines are rotated so they are parallel or

normal to the test lines the illusion is eliminated. This classification permits a number of apparently different illusions, including the Hering, Zollner, and Ponzo illusions, to be considered related. Author (TAB)

N68-13257 Bureau of Mines, Pittsburgh, Pa. Health and Safety Research and Testing Center.
MINIATURE OXYGEN DEFICIENCY ALARM
Merle L. Bowser and Robert A. Bradburn Jan. 1968 11 p
(BM-IC-8358)

The Bureau of Mines has constructed a miniature oxygen deficiency alarm system using an electrochemical cell as the sensor. Distinct audible signals are produced at either of two preselectable oxygen levels which can be varied from approximately 10 to 20.9% oxygen. The high or cautionary range produces a 500-cycle-per-second tone pulsed at about a 1-cycle-per-second rate, whereas the lower or more dangerous oxygen level produces a continuous 500-cycle-per-second tone. Author

N68-13286# Systems Technology, Inc., Hawthorne, Calif.
CARDINAL RECONSTRUCTION THEORY OF TOOL FOR ESTIMATING EFFECTS OF DISPLAY SCANNING
Warren F. Clement 1 Mar. 1967 45 p refs
(Contract N00014-66-C-0072)
(TM-163-B; AD-661854)

A review of sampling processes and forms of continuous signal reconstruction therefrom has revealed several forms which may be useful in modeling the average display scanning behavior of the human operator. The most promising form appears to be cardinal reconstruction. Low frequency approximations to the effective time delay for truncated cardinal reconstruction are only slightly less than for linear reconstruction. The influence of sampled first derivative and of sampled dwell time appear analogous to the influence of sampled prediction in reducing the effective reconstruction time delay. The implications of these results for the measurement and interpretation of multi-instrument display tracking are discussed. Author (TAB)

N68-13436*# Public Health Service, Washington, D. C.
EVALUATION OF LEAKAGE OF MICROBIAL CONTAMINATION FROM GEMINI SPACE SUIT Final Report
Oct. 1967 10 p
(NASA Order R-137)
(NASA-CR-91468) CFSTI: HC $3.00/MF $0.65 CSCL 06K

An adult male clothed in a pressurized Gemini space suit participated in an experiment to measure the leakage of microorganisms from the space suit into an ambient environment. Microbial leakage was measured in both a plastic-film shedding chamber and in a stainless steel shedding chamber or microbiotank. Microspores were not observed in any of the tests, although it was shown that viable microorganisms shed into the Gemini space suit leaked into the ambient temperature. The amount of shedding varied, although it was not determined whether this was due to the actual rate of microbial shedding or the amount of leakage. M.W.R.

N68-13474# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COMMUNICATIONS BIOPHYSICS
S. K. Burns, P. R. Gray, R. W. Henry, P. G. Katona, N. P. Moray et al. *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 169–189 refs (See N68-13461 04-23)
(Grant NIH-1-P01-GM-14940-01)

Preliminary work on a model of binaural hearing, in which the firing patterns on the auditory nerve are regarded as inputs to a central processor, rests on the assumptions that: (1) the activity in the nerves is characterized by the firing times of the fibers, (2) the inputs to the processor are sample functions from random-point processes, and (3) the central processor has no absolute time reference. The limitations on performance imposed by the peripheral transformation are separated from the limitations imposed by the central processor and the results are then used to form a more realistic model of the processor. Comparison of model predictions with empirical data showed consistency for the case of interaural amplitude, and better than real performance predictions for the case of interaural time. Studies of the effect of a just-previous trial on a subject's response in the context of a monaural, two-alternative-forced-choice, intensity-discrimination task showed a strong individual dependency of the discriminating threshold. G.G.

N68-13479*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEMS RELATING TO DRYNESS IN THE UPPER AIR LANES DURING JET FLIGHTS [TOERHEDSPROBLEMER IOEVRE LUFTVEJE UNDER JET FLYVNING]
J. Fritze Dec. 1967 8 p refs Transl. into ENGLISH from Militaerlaegen (Denmark), v. 72, 1965 p 13–21
(NASA-TT-F-11295) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Problems in high-altitude jet flying are discussed from the physiological and psychological viewpoint. Emphasis of the investigation is on possible permanent or transient damage to the organism by low relative humidity of cabin air. Remedial measures are mentioned, including individual humidifiers, wearing of artificial noses familiar from post-tracheotomy therapy, and careful supervision of otologic conditions of crew members. Author

N68-13489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A LOOK FORWARD (SCIENTISTS COMMENT ON THE FLIGHT) [ZAGLYADYVAYA VPERED]
N. Gurovskiy and B. Yegorov 21 Feb. 1967 9 p Transl. into ENGLISH from Izv. (Moscow), 25 Mar. 1965 p 3
(FTD-HT-66-427; AD-661765)

It is believed that the training of cosmonauts for future multiplace spaceships should be designed to fit the professional training of each candidate. Previous flights have shown that difficulties encountered in weightlessness were a result of the individual peculiarities of the organism and were not a reflection of the degree of physical training. The health requirements and the training program itself should reflect the fact that crews of future flights will consist of specialists of various professions. Although spaceship commanders will have to meet the strictest requirements and train far more intensively than cosmonauts performing a scientific or other specialty role, the need for cosmonauts to have ideal health is no longer considered an inflexible requirement. Cosmonauts for future flights may be selected on the basis of their professional training even if they have certain defects in the condition of their health or the level of their general physical training. Author (TAB)

N68-13496# Advisory Group for Aerospace Research and Development, Paris (France).
PROBLEMS OF VISION IN LOW LEVEL FLIGHT [LES PROBLEMES VISUELS DU VOL A BASSE ALTITUDE]
A. Mercier, G. Perdriel, and T. C. D. Whiteside 1967 85 p refs In FRENCH and ENGLISH
(AGARDograph-107; AD-661164) CFSTI: HC $3.00/MF $0.65

The problem areas considered seem to fall naturally into four broad categories. These are: the external environment; mans response to this environment; human engineering considerations as a result of mans limitations; and, finally, selection and training for

this arduous task of low-level flying, in which the tolerable margin of error is probably less than in most other phases of flight.
Author (TAB)

N68-13556* National Aeronautics and Space Administration, Washington, D. C.
THE SUBJECTIVE EFFECTS OF TIME SHIFT (POLL TAKEN AMONG THE FLIGHT PERSONNEL OF AIR FRANCE) [LES EFFETS SUBJECTIFS DES DECALAGES HORAIRES (UNE ENQUETE AUPRES DU PERSONNEL NAVIGANT D'AIR-FRANCE)]
J. Lavernhe, E. Lafontaine, and R. Laplane Nov. 1967 11 p refs Transl. into ENGLISH from Rev. Med. Aeron. (Paris), v. 4, no. 15, 1965 p 30–36
(NASA-TT-F-11370) CFSTI: $3.00 CSCL 06N

The effects of time shifts on crews in long-distance flights are discussed, with a comparison of Transatlantic and Far-East flights. Changes in eating, sleeping, and nervous habits are tabulated for various age groups of flying personnel. Least trouble was experienced by older crew members who retained the time schedule of their country of origin during layover in other countries. Ideal stay during layover, under present conditions, is one day and one night. Reduction in harmfulness of time-change effects is expected from change-over to supersonic transports. It is suggested to keep flying personnel within a sector of relatively homogeneous time shifts, avoiding flights with repeated crossing of the international date line.
Author

N68-13609*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A PILOTED FIXED-BASE SIMULATOR STUDY OF LOW-SPEED FLIGHT CHARACTERISTICS OF AN ARROW-WING SUPERSONIC TRANSPORT DESIGN
William D. Grantham and Perry L. Deal Jan. 1968 39 p refs
(NASA-TN-D-4277) CFSTI: HC $3.00/MF $0.65 CSCL 01B

A piloted fixed-base simulator study has been made to determine the low-speed flight characteristics of an arrow-wing supersonic transport configuration. The transport-type cockpit was equipped with normal flight controls and a flight instrument display representative of those found in current transport aircraft. The results indicated that although the longitudinal short-period damping ratio was at a good level (0.84), the pitch damping appeared to be low to the pilot because of the low frequency of the short-period oscillation. This low pitch damping and the sluggish pitch response made the longitudinal handling qualities of the basic configuration unsatisfactory. When the static stability, the damping in pitch, the elevator effectiveness, and the elevator to column gearing were increased by a sufficient amount, the lateral-directional handling qualities of the basic configuration were said to be unacceptable because of the poor roll control characteristics and the uncontrollable Dutch roll. When the effective dihedral was decreased by a sufficient amount, and the damping in roll and yawing moment due to roll were increased by a sufficient amount, the Cooper rating was improved to 2.5.
Author

N68-13621* National Aeronautics and Space Administration, Washington, D. C.
ANTHROPOTECHNIQUE AS A SCIENTIFIC DISCIPLINE [DIE ANTHROPOTECHNIK ALS WISSENSCHAFTLICHE DISZIPLIN]
R. Bernotat Dec. 1967 14 p Transl. into ENGLISH from German Presented at Ann. Meeting of WGLR, Bad Godesberg, West Germany, 4–8 Oct. 1966
(NASA-TT-F-11390) CFSTI: $3.00 CSCL 05H

Subjects and problems treated in anthropotechnique—a new science defined as the science pertaining to the relationship between man and machine—is discussed. The environmental layout, the dynamic adaptation of the machine to man, and the limits of intelligent machine handling are the aspects discussed specifically. Simulation methods are regarded as the most effective aids to the scientist who works in the field.
Author

N68-13638*# Case Inst. of Tech., Cleveland, Ohio. Solid State Electronics Lab.
[INVESTIGATION OF IMPLANTABLE MULTICHANNEL BIO-TELEMETRY SYSTEMS] Semiannual Report, Mar.–Sep. 1967
W. H. Ko, E. Yon, and W. Thompson Nov. 1967 26 p
(Grant NGR-36-003-079)
(NASA-CR-91524; SAR-2) CFSTI: HC $3.00/MF $0.65 CSCL 06B

Continued research conducted under a program designed to develop a system design and fabrication techniques for multiple channel, physiologically implantable, telemetering systems is reported. The design is to be flexible, allowing several channels of information to be handled simultaneously, and to be able to telemeter a wide range of physiological signals. The single channeled FM/FM strain gage system which was implanted in a dog performed well for a period of four months, failure being attributed to a wire breakage. A system having four strain gage pickups was fabricated using microminiature standard components, and a receiving and demodulating system was constructed for this transmitter. This four channel system was implanted and performed satisfactorily initially; however, water proofing failed after a period of one week. Hybrid integrated circuits were designed and fabricated for a four channel strain gage system. These circuits are being tested in a breadboard unit and are functioning well with the addition of a few external components. These integrated circuits will be packaged for a four channel strain gage unit. Circuitry has been breadboarded and incorporated into the integrated circuit test unit which will allow EKG signals to be handled. The breadboard has eight information channels plus sync and AGC channels. The receiving and demodulating system is being expanded to handle this system.
S.C.W.

N68-13712# United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch.
THE PLACE OF LUMINESCENCE DOSIMETRY IN THE CONTROL OF OCCUPATIONAL HAZARDS OF IONIZING RADIATION
W. A. Langmead *In* NRL Luminescence Dosimetry Apr. 1967 p 359–362 (See N68-13681 04-14)

The objectives of a personnel monitoring program are reviewed, and the main characteristics of systems based on the film badge and luminescent devices are discussed. The requirements to meet the main objectives are summarized; it is suggested that the following dosimeter components satisfy these requirements: a lithium fluoride dosimeter that may be incorporated into the film holder or worn separately adjacent to the badge, a multifilter film badge that may act as a simple spectrometer as well as a dosimeter, and small lithium fluoride dosimeters for special purposes.
Author (NSA)

N68-13717# Edgerton, Germeshausen and Grier, Inc., Goleta, Calif. Santa Barbara Div.
A MINIATURE THERMOLUMINESCENT DOSIMETER AND ITS APPLICATION IN RADIOECOLOGY
Arthur C. Lucas and Norman R. French (Calif. Univ., Los Angeles) *In* NRL Luminescence Dosimetry Apr. 1967 p 402–411 refs (See N68-13681 04-14)
(Contract AT(29-1)-1183)

A glass-capillary dosimeter, having an outside diameter of 0.8 mm and a length of 6.0 mm, was constructed and used

in radiation tests with reptiles and rodents serving as subjects. The glass tubes are filled with powdered CaF_2:Mn or LiF (TLD-100 or TLD-700). The dosimeter is externally heated by a coil of Nichrome wire. The emitted light is measured with a photomultiplier used in conjunction with an electrometer. The dosimeter was designed for use in a radioecology study involving irradiation of a 20-acre desert site with ^{137}Cs γ rays. The dosimeters were utilized in the 1- to 1000-R range of exposures and were found to have a precision of ± 0.1 R or $\pm 3\%$, whichever is greater. Measurements of γ-ray exposure vs. depth have been performed with both CaF_2:Mn and LiF to depths in the earth of 30 cm, with the measurement period extending over 1 month. Single dosimeters were attached to individual members of a periodically trapped rodent population, and measurements were made of the actual exposures given the irradiated animals. Author (NSA)

N68-13727 System Development Corp., Santa Monica, Calif.
EXPERIMENTAL STUDIES OF RELEVANCE JUDGMENTS. VOLUME 1: PROJECT SUMMARY Final Report
30 Jun. 1967 130 p refs
(Contract NSF C-424)
(TM-3520/001/00, V. 1)

This is the first volume in a three-volume report on a project to develop empirical information on human relevance assessment. Evidence has been developed that suggests that relevance judgments can be and are influenced by the skills and attitudes of the particular judges used, the documents and document sets used, the particular information requirement statements, the instructions and setting in which the judgments take place, the concepts and definitions of relevance employed in the judgments, and the type of rating scale or other medium used to express the judgments. These findings cast serious doubt on the wisdom of treating relevance scores as stable criteria for system or subsystem evaluation in those instances where the sources of variation cited above have not been recognized and properly controlled. The practical and research implications of these findings are discussed and recommendations are made for priority work on the interface between the user and the information system. Author

N68-13728 System Development Corp., Santa Monica, Calif.
EXPERIMENTAL STUDIES OF RELEVANCE JUDGEMENTS. VOLUME 2: DESCRIPTION OF INDIVIDUAL STUDIES Final Report
30 Jun. 1967 136 p refs
(Contract NSF C-424)
(TM-3520/002/00, V. 2)

This is the second volume in a three volume report on a project to develop empirical information on human relevance assessment. Detailed descriptions are presented of the fifteen individual studies performed during the course of the project. Each description contains details on the background, purpose, experimental procedures, data analysis, results, and conclusions. Some of the materials and forms used in the studies are included where needed for adequate understanding. A complete display of materials and forms for all experiments is contained in Volume III, while cross study comparisons and integration of findings from individual studies can be found in Volume I. R.N.A.

N68-13729 System Development Corp., Santa Monica, Calif.
EXPERIMENTAL STUDIES OF RELEVANCE JUDGEMENTS. VOLUME 3: COMPILATION OF FORMS, GUIDES, SCHEDULES, AND INSTRUCTIONS USED IN THE STUDIES Final Report
30 Jun. 1967 234 p refs
(Contract NSF C-424)
(TM-3520/003/00, V. 3)

This is the third volume in a three-volume report on a project to develop empirical information on human relevance assessment. The project involved fifteen individual studies. These appendices include all materials developed and used in the experiments and studies conducted during the course of the project. Materials for each experiment or study are presented in a separate appendix. Author

N68-13901# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
TIME DOMAIN IDENTIFICATION OF HUMAN OPERATOR DYNAMIC RESPONSE
S. Suh Dec. 1967 67 p refs
(RM-392)

The problems encountered in the human operator identification process in the time domain are examined, and a solution is suggested. The problems are identified as selection of an identification technique, selection of an error signal on which the identification system is based, and determination of a correct measurement that leads to noise-unbiased parameters of the human operator model. The major portion of the work is devoted to detailed analysis of three selected identification techniques with a view to their further improvement and application. An important finding is that the human operator identification process should be carried out with closed-loop measurements and with the output error based system. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-12868*# South Carolina Univ., Columbia.
THE INFRARED AND RAMAN SPECTRA OF BIS(TRIFLUOROMETHYL)PEROXIDE
[1967] 19 p refs Submitted for publication
(Grant NGR-41-002-003)
(NASA-CR-91342) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The gas phase infrared spectrum as well as the liquid phase Raman data of bis(trifluoromethyl)peroxide are reported from 33 cm^{-1} to 3000 cm^{-1} and from 200 cm^{-1} to 1400 cm^{-1}, respectively. An assignment of the twenty-four normal modes is suggested and discussed. Only one CF_3 torsion is found at 64 cm^{-1}, and the barrier to internal rotation is calculated to be 5.4 kcal/mole. The O–O torsional mode is also observed, but due to a lack of data only a very rough estimate may be given for the cis barrier, 16 ± 6 kcal/mole. Author

N68-12876# Duke Univ., Durham, N. C. Microwave Lab.
[MICROWAVE, MILLIMETER, AND RADIOFREQUENCY SPECTROSCOPY] Final Report, 1 Oct. 1965–30 Sep. 1967
12 Oct. 1967 11 p refs
(Grant AF-AFOSR-493-66)
(AFOSR-67-2668; AD-661974)

A summary is given of a research program which involved studies of (1) the millimeter and submillimeter wave spectra of a number of gaseous molecules; (2) electron spin resonance of simple free radicals trapped in solidified inert gas matrices; and (3) the effects of radiation on DNA and RNA, mainly by ESR. A list of papers resulting from the work is included. TAB

N68-12885# Imperial Coll. of Science and Technology, London (England).

CHROMATOGRAPHY AND SOLVENT EXTRACTION OF ORGANOMETALLIC COMPLEXES Final Summary Report, Oct. 1963–Sep. 1966

D. A. Pantony Sep. 1966 21 p refs

(Contract AF 61(052)-663)

(ARL-67-0191; AD-661325)

A summary is given of work aimed at the synthesis and study of new metal coordination complexes and ligands based on 8-hydroxy quinoline. A comprehensive equation was developed and verified which describes the efficiency of extraction of cations, as organometallic molecular chelates, into organic solvents in terms of various known equilibria and in terms of changes of hydrogen ion concentration. 2-Ethyl- and 2-isopropyl-8-quinolinols were synthesized and examined in detail with respect to the solvent extraction of their chelates. The chromatographic studies were largely concerned with the factors which influence the adsorption of 8-quinolinol and 2-methyl-8-quinolinol chelates. TAB

N68-12901*# Northeastern Univ., Boston, Mass. Dept. of Chemistry.

INVESTIGATION OF NEW SYSTEMS FOR POTENTIAL LASER ACTION Progress Report, 1 Jul.–31 Oct. 1967

Karl Weiss 21 Nov. 1967 10 p refs

(Grant NGR-22-011-025)

(NASA-CR-91292; PR-1) CFSTI: HC $3.00/MF $0.65 CSCL 07B

A literature survey was made of metallic compounds for systems potentially capable of lasing. Three classes of compounds emerged as potential sources of investigation: metal carbonyls, metal chelates, and metal halides. On the basis of the literature survey a decision was made to investigate several metal halides of the type MX_2 and some metal chelates in the vapor phase. The metal halides selected are those of mercury, zinc, cadmium, lead, and calcium. The chelates chosen are those involving the transition metals, rare earths, copper and thallium with beta-diketones, and 8-hydroxyquinoline as ligands. The sequence of planned experimental work for both these groups is briefly discussed along with the status of the apparatus for these experiments. R.N.A.

N68-12926# Explosives Research and Development Establishment, Waltham Abbey (England).

SYNTHESIS AND CHARACTERISATION OF HYDROXY-TERMINATED POLYBUTADIENES

D. H. Richards, D. A. Salter, and R. L. Williams 4 Jan. 1967 21 p refs

(ERDE-6/R/66; AD-661501)

An adaptation of the Szwarc living polymer method was used to synthesise hydroxy-terminated polybutadienes up to 11,000 molecular weight which were characterised by infra-red and nuclear magnetic resonance spectroscopy. The latter technique indicates that the materials are predominantly 1,2-linked, and analysis by chemical and physical methods shows that the production of hydroxy-terminal groups is virtually quantitative. It is possible to react these polymers with 2,4-tolyene diisocyanate to yield thermoplastics, which can be crosslinked with castor oil to give good quality rubbers. Author (TAB)

N68-12941# Little (Arthur D.), Inc., Cambridge, Mass.

CATION EXCLUSION BY INTERFACIAL WATER STRUCTURE

R. A. Horne and R. P. Young 15 Dec. 1967 14 p refs

(Contract Nonr-4424(00))

(TR-32; AD-661871)

As an interface is approached pure water and aqueous electrolytic solutions become increasingly structured. This enhanced structure tends to exclude water-structure altering solutes. A series of simple elution studies using 80-120 mesh silica, on 0.10M solutions of the alkali chlorides shows that the extent of exclusion of these cations is correlated with their viscosity B-coefficients, a measure of their effect on water structure. Author (TAB)

N68-12957 United Kingdom Atomic Energy Authority, Windscale (England). Production Group.

A METHOD FOR THE SEPARATE COLLECTION OF KRYPTON AND XENON FROM REACTOR COOLANT GAS IN PREPARATION FOR GAMMA SPECTROMETRIC COUNTING

R. L. D. French 1967 9 p

(PG-807(W)) HMSO: 1s 9d

This method separately extracts xenon and krypton from a sample of reactor coolant gas and will reject any argon present. The separation is achieved by passing a sample of "residual gas" (obtained after bubbling some reactor coolant gas through potassium hydroxide solution), through two cooled, charcoal-filled traps connected in series. The traps may then be counted directly. Author

N68-12958# United Kingdom Atomic Energy Authority, Windscale (England). Production Group.

ANALYTICAL METHOD FOR THE DETERMINATION OF NORMAL BUTYL ALCOHOL IN TRIBUTYL PHOSPHATE. GAS CHROMATOGRAPHY

E. Hughes and L. B. Chadwick 1967 5 p

(PG-806(W)) HMSO: 1s 2d

A known weight of n-tridecane is added to the sample. The mixture is chromatographed on a Celite column containing 10% by weight of polyethylene glycol 400, and the ratio of the heights of the peaks due to n-tridecane and n-butyl alcohol is used to obtain the concentration of n-butyl alcohol. Author

N68-13014# Monsanto Research Corp., Dayton, Ohio.

PHYSICAL PROPERTIES OF SELECTED β-DIKETONES Interim Report, 10 Jun.–25 Jul. 1967

William G. Scribner Wright-Patterson AFB, Ohio ARL Sep. 1967 29 p refs

(Contract AF 33(615)-1093)

(ARL-67-0189; AD-661556)

Literature values or experimental data are given for the boiling points, refractive indices, densities, and ionization constants of 2,4-pentanedione, 1,1,1-trifluoro-2,4-pentanedione, 1,1,1,5,5,5-hexafluoro-2,4-pentanedione, 1,1,1,2,2,6,6,6-octafluoro-3,5-hexanedione, 1,1,1,2,2,3,3,7,7,7-decafluoro-4,6-heptanedione, 1,1,1,2,2,3,3-heptafluoro-7,7-dimethyl-4,6-octanedione, and 2,2,6,6-tetramethyl-3,5-heptanedione. Infrared spectra and proton and fluorine NMR spectral data are also presented. References are given for commercial sources or preparative methods for these and twenty-nine other fluorine-containing beta-diketones. Author (TAB)

N68-13019 Technische Hochschule Munchen (West Germany). Fakultaet fuer Allgemeine Wissenschaften.

CYCLOBUTENES OF THE PYRROL, INDOL, AND PHENOL SERIES—CONDENSATION REACTIONS OF 1,2-DIHYDROXY CYCLOBUTENDION [CYCLOBUTENDERIVATE DER PYRROL-, INDOL- UND PHENOLREIHE—KONDENSATIONS-REAKTIONEN DER QUADRATSAEURE]

Karl Jacob [1967] 96 p refs In GERMAN

Condensation of 1,2-dihydroxy cyclobutendion (QS) with alkyl substituted α-pyrroles resulted in a group of violet-red dipyrryl-dioxotetracyclotrimethene dyes. Ultraviolet, infrared, and nuclear magnetic resonance spectra of the obtained betaines

confirmed their acid characteristics. Analog indol and phenol dyes were also obtained. Condensation of hydroxy cyclobutendions with α,α'-free pyrrol resulted in a QS-bis dye synthesis. Transl. by G.G.

N68-13038 United Kingdom Atomic Energy Authority, Springfields (England). The Reactor Group.
THE FLUIDISED BED COATING OF URANIUM MONOCARBIDE WITH SILICON CARBIDE
L. H. Ford, N. S. Hibbert, B. E. Ingleby, and D. E. Y. Walker 1967 18 p refs Submitted for publication
(TRG-1544(S))

Pyrolytic silicon carbide has been applied to uranium monocarbide kernels in a 1-1/2 in. dia. fluidized bed unit from methyl trichlorosilane in the presence of hydrogen or hydrogen/argon mixtures at 1200–1700°C. At a deposition temperature of 1200°C the silicon carbide coatings contain free silicon and carbon, whereas in the temperature range 1500–1650°C the coatings are essentially β-SiC. In this temperature range variations of deposition rate influence the density, structure and α-SiC content of the coating. At low deposition rates, less than 200 g/h, dense β-SiC is deposited with a coarse granular structure, but smooth outer surface. At high deposition rates, greater than 200 g/h, the coats were porous and contained disordered α-SiC. Partial replacement of the hydrogen fluidizing gas with argon led to disordered α-SiC and porosity in the coating. Increasing the deposition temperature still further to 1700°C caused reaction between the UC and SiC. Author

N68-13062 United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
THE ROLE OF DESALINATION IN WATER SUPPLIES
H. Kronberger and R. S. Silver (Glasgow Univ.) 1967 5 p Presented at Intern. Conf. on Water for Peace, Washington, D. C., 23–31 May 1967 Submitted for publication
(TRG-1536(R))

A program was undertaken to exploit the development potential of flash distillation to supply a combination of nuclear power and desalination plants, and to investigate alternative methods of desalination. Dual-purpose power and desalination plants have the advantage of using all the waste heat from power-station operation for the desalination of water, at the expense of a small drop in generating efficiency. They can be optimized to give cost benefits in producing both power and water for industrial and domestic use. Nuclear power systems being studied are the Advanced Gas-cooled Reactor and the Steam Generating Heavy Water Reactor, both chosen because of high availability and excellent safety characteristics. For desalination of brackish water, reverse osmosis and electrodialysis are being studied, and an improved electrodialysis plant was commissioned. A shipborne desalination plant was designed for supplying water to groups of small islands. Author

N68-13075# Naval Ordnance Lab., White Oak, Md. Chemistry and Explosives Research Area.
THE CHEMISTRY OF DETONATIONS. 1: A SIMPLE METHOD FOR CALCULATING DETONATION PROPERTIES OF C–H–N–O EXPLOSIVES
Mortimer J. Kamlet and S. J. Jacobs Aug. 1967 49 p refs
(NOLTR-67-66; AD-661483)

Simple empirical equations are given which permit the calculation of the detonation pressures and velocities of C-H-N-O explosives. The detonation pressures so derived correspond quite closely to values predicted by the computer code RUBY (see AEC report UCRL-6815 or NASA report N62-16450), which employs the most recent parameters and covolume factors with Kistiakowsky-Wilson equation of state. TAB

N68-13111# Fulmer Research Inst., Ltd., Stoke Poges (England).
HEAT OF FORMATION OF ALUMINIUM CHLORIDE
P. Gross and C. Hayman 29 Sep. 1967 16 p refs
(Contract AF 61(052)-863)
(R-163/SR/4; AFOSR-67-2638; SR-4; AD-661565)

By chlorinating aluminium under pressure in a glass combustion vessel, a value of -168.8 kcal/mole was obtained for the standard heat of formation of aluminium chloride. The total error is considered to be less than plus or minus 0.20 kcal. TAB

N68-13233* Yale Univ., New Haven, Conn.
A MODEL SYSTEM OF REACTING H_2 AND I_2 Final Progress Report
Philip Rosen and Harold J. Morowitz [1967] 10 p
(Grant NGR-07-004-041)
(NASA-CR-91339) CFSTI: $3.00 CSCL 07B

Equations are evolved for calculating the steady state concentrations of a model system of reacting H_2 and I_2 at temperature T which is separated by a Knudsen barrier from a similar system at temperature $T+\Delta T$. The model system has the properties of chemical reaction and transport, and the Knudsen barrier permits transport without introducing derivatives with respect to distance. A numerical evaluation considers internal energies and kinetic energies by dealing with vibration uncoupled from rotation and assuming a simple harmonic motion for vibration. M.W.R.

N68-13251# McMaster Univ., Hamilton (Ontario). Metallurgy and Materials Science Dept.
IONIC DIFFUSION IN SOLID METAL OXIDES Final Report, Oct. 31, 1965–Oct. 31, 1967
W. W. Smeltzer 31 Oct. 1967 5 p refs
(Grant AF-AFOSR-515-66)
(AFOSR-67-2633; AD-661579)

A summary is given of experimental investigations which were completed on the properties of oxide films on metals and alloys, and on oxygen diffusion in metal oxides as single crystals, spheres and films, and theoretical analyses which were completed for the diffusion processes of nickel in nickel oxide films and oxygen in niobium pentoxide and zirconia. TAB

N68-13266# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
VAPOR PRESSURES OF LIQUID MOLYBDENUM (2,890° TO 2,990°K) AND LIQUID ZIRCONIUM (2,229° TO 2,795°K)
Robert K. Koch and W. E. Anable Jan. 1968 27 p refs
(BM-RI-7063)

The vapor pressures of liquid molybdenum and liquid zirconium were determined by the Langmuir free-evaporation method. An electron-beam furnace with a water-cooled copper crucible was used for melting. Temperature was measured with a two-color ratio pyrometer. The vapor-pressure data led to the following equations: $\log p\ (atm) = 5.429\ 28.380/T$ for liquid molybdenum in the range 2,890° to 2,990°K, and $\log p\ (atm) = 6.521 - 30,940/T$ for liquid zirconium in the range 2,229° to 2,795°K. Third-law evaluations of each data set gave mean heats of sublimation (298.15°K) of 157.6 ± 1.8 kcal/mole and 148.4 ± 2.4 kcal/mole for molybdenum and zirconium, respectively, where the uncertainties are two standard deviations. Second-law standard heats of sublimation determined from sigma plots and tabulated enthalpies were 143.5 ± 2.7 kcal/mole and 149.2 ± 3.8 kcal/mole for molybdenum and zirconium, respectively. Author

N68-13295# Bureau of Mines, Minneapolis, Minn. Twin Cities Metallurgy Research Center.

KINETICS OF FORMATION OF CARBON DIOXIDE AND CARBON FROM CARBON MONOXIDE IN PRESENCE OF IRON PELLETS

Larry A. Haas, S. E. Khalafalla, and P. L. Weston, Jr. Jan. 1968 35 p refs

(BM-RI-7064)

A kinetic study of the carbon deposition reaction was undertaken as part of a broad investigation of metallurgical reactions in the iron ore blast furnace. The disproportionation of carbon monoxide on iron pellets was investigated at carbon monoxide pressures between 0.5 and 2 atmospheres (absolute) and temperatures from 400° to 1,075°C. Gas flow in the range from 0.25 to 0.85 standard liter per minute was found to have little effect on the reaction velocity. The addition of nitrogen and helium to carbon monoxide exerted only a dilution effect on the rate of carbon deposition. However, an addition of 1 percent hydrogen increased the rate about 100 times. Small amounts of carbon dioxide in the inlet gas exerted little effect on the rate of carbon deposition. The maximum rate for carbon deposition in the first 2 hours occurred at 550°C. The apparent molar activation energies at various stages of the reaction were found to vary from 13 kcal initially to 36 kcal during the latter stages of the reaction. The reaction rate behavior was tentatively explained by an adsorption step followed by the diffusion of iron through a shell of inactive iron carbide. Author

N68-13361# Hunter Coll., New York.

ION EXCHANGE RESINS: FOCUSED LASER DEGRADATIONS Progress Report, Sept. 1, 1966–Aug. 30, 1967

Richard H. Wiley 25 Sep. 1967 4 p refs

(Contract AT(30-1)-3644).

(NYO-3644-11; PR-2) CFSTI: HC $3.00/MF $0.65

Research on ion-exchange resins prepared from bead copolymers of styrene and divinylbenzene and on focused laser experiments to determine their plasma characteristics in chemical substances is described. NSA

N68-13364# Harvard School of Public Health, Boston, Mass.

DYNAMIC ADSORPTION OF FISSION-PRODUCT NOBLE GASES ON ACTIVATED CHARCOAL

Dwight W. Underhill Apr. 1967 146 p refs

(Contract AT(30-1)-841)

(NYO-841-8) CFSTI: HC $3.00/MF $0.65

Since the ideal absorption of fission gases is not observed, generally, because some of the fission gases pass through the bed long before saturation is approached, a study was made of the effect that these deviations from ideal behavior have on the efficiency of adsorption in charcoal beds. Experimental measurements were made of the adsorption and desorption of ^{85}Kr in an air carrier in charcoal beds cooled with dry ice. These measurements extended over a wide range of flow velocities and charcoal particle diameters; both coconut base and petroleum base charcoals were tested. From an analysis of the spreading of the fronts of ^{85}Kr passing through the beds, three mechanisms of mass transfer were found to be important. These are: diffusion in the mobile phase; axial dispersion; and stationary phase mass transfer resistance. Calculations applying mass transfer data to the design of fission gas absorption beds are also given, with particular emphasis on the design of fission gas holdup beds. NSA

N68-13383# Princeton Univ., N. J.

[CHEMISTRY DEPARTMENT ANNUAL PROGRESS REPORT, JUNE 1, 1966–JUNE 1, 1967]

John Turkevich 15 Jun. 1967 9 p refs

(Contract AT(30-1)-1158)

(NYO-1158-21) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: metal catalysts; molecular sieves; transition oxide systems; kinetics of homogeneous reactions; and characterization of catalysts. NSA

N68-13390# Harvard School of Public Health, Boston, Mass.

SEPARATION OF ^{85}KR FROM HYDROGEN BY SELECTIVE DIFFUSION THROUGH PALLADIUM–SILVER MEMBRANES

Dwight W. Underhill Apr. 1967 19 p refs

(Contract AT(30-1)-841)

(NYO-841-9) CFSTI: HC $3.00/MF $0.65

In a series of tests ranging from one-half hour to nine and one-half hours, diffused hydrogen was obtained from a hydrogen feed containing 4.0×10^{-2} μCi/(ml.) of krypton-85. At no time during any of these tests was krypton-85 detected in the diffused hydrogen. The minimum separation factor, calculated from the ratio of the concentration of krypton-85 in the bleed stream to the minimum detectable concentration of krypton-85 in the diffused hydrogen, was at least greater than 10^5. In a subsequent test, a hydrogen–krypton-85 mixture was placed on one side of the diffusion membrane, and after 248 hours, the hydrogen on the other side of the barrier was drawn off and tested for the presence of krypton-85. The separation factor of the diffusion membrane, consistent with the absence of detected diffused krypton-85, is at least 3×10^{12}, showing the very high selectivity of the membrane. Author (NSA)

N68-13416# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

THE CONDENSATION AND SUBLIMATION OF CO_2 WITH H_2O: CARBONIC ACID ON MARS?

Halstead Harrison, D. M. Scattergood, and M. R. Shupe Sep. 1967 13 p refs

(D1-82-0653; AD-661385)

The condensation and sublimation of mixtures of CO2 with H2O have been studied at temperatures between 80 and 230 K. Evidence is presented for the existence of metastable, solid-phase H2O.CO2. With near-equilibrium condensation the measured heats of sublimation of CO2 and H2O are independent of the mixing ratio; it is therefore unlikely that CO2 and H2O will co-precipitate on Mars at temperatures appreciably higher than required for CO2 to condense alone. Author (TAB)

N68-13421 Ministry of Technology, London (England). Technical Information and Library Services.

DECOMPOSITION OF POLYOXYMETHYLENE AND POLYOXYMETHYLENE DIACETATE IN PHENOL SOLUTIONS

Y. Fukuda and H. Kaito Dec. 1967 13 p refs Transl. into ENGLISH from Mippon Kagaku Zasshi (Tokyo), v. 66, no. 3, 1963 p 387–390

(TIL/T-5474)

Decomposition was measured at 90–132 deg.C. Polymer decrease in weight agreed with a first-order reaction; the rate was higher for POM than for POMDA, but total activation energies were almost equal. A theoretical mechanism of decomposition is put forward. It is concluded that reaction begins at both ends of the POM molecule as well as in the molecular chain; but only in the molecular chain with POMDA. Author

N68-13446# Aerospace Corp., El Segundo, Calif. Lab. Operations.

CHEMICAL VAPOR DEPOSITION OF HAFNIUM CARBIDE

W. R. Wilcox, J. R. Teviotdale, and R. A. Corley Oct. 1967 21 p refs

(Contract F04695-67-C-0158)

(TR-0158(3250-10)-3; SAMSO-TR-67-77; AD-661960)

Chemical vapor deposition of hafnium carbide yielded whiskers, needles, dendrites, faceted crystals, and adherent coatings. The gas stream compositions and the mass transfer conditions determined the habit of deposit. The deposits were obtained at temperatures ranging from 1100 to 1800C. Author (TAB)

N68-13478*# State Univ. of New York, Stony Brook.
THERMODYNAMIC PROPERTIES OF INTERSTITIAL ELEMENTS IN THE REFRACTORY METALS Semiannual Report, 1 Jun.–30 Nov. 1967
P. P. Bansal, N. C. Birla, A. C. Huang, and L. Seigle 30 Nov. 1967 14 p refs
(Grant NGR-33-015-035)
(NASA-CR-91521; SAR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Assembling and testing the high temperature galvanic cell for experimental measurement of the thermodynamic properties of the interstitial elements by the emf method was investigated. The cell was operated with a solid ZrO_2+CaO electrolyte, and electrodes of Ni+NiO and $Cu+Cu_2O$, yielding values for the free energy, enthalpy, and entropy of the reaction $Ni+Cu_2O=2Cu+NiO$ at 900°C in good agreement with those in the literature. Author

N68-13494 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.
THE RADIATION CHEMISTRY OF THE ANTHRACENE OIL COMPONENTS [DIE STRAHLENCHEMIE DER ANTHRAZENOELBESTANDTEILE]
E. Proksch, F. Wiesinger, W. Szinovatz, and H. Eschweiler [1967] 41 p refs In GERMAN; ENGLISH summary
(SGAE-CH-47/1967) CFSTI: $3.00

The liquid phase radiolytical decomposition of higher aromatic hydrocarbons has been determined using nuclear reactor radiation (about 80% of the dose due to absorption of gamma radiation). The strong decrease of decomposition with increasing resonance energy is thought to be caused by the competition between radiationless conversion of excitation energy and decomposition of excited molecules. In the critical region near the C-H-dissociation energy, increasing resonance makes the distances between successive excited energy levels to decrease and thus the rates of non-radiative conversion to increase. By comparison the stabilities of the anthracene oil components in the oil itself, the existence of radical scavenging reactions could be proven for higher aryl radicals, too. The importance of these findings for the question of feasibility of anthracene oils as nuclear reactor coolants is discussed. Author

N68-13518# Monsanto Research Corp., Dayton, Ohio.
STUDIES OF LOW-TEMPERATURE OXIDATION REACTIONS Summary Report No. 4, 1 Oct. 1965–31 Jan. 1967
Leo Parts and John T. Miller, Jr. 31 Oct. 1967 92 p refs
(Contract Nonr-3977(00))
(MRC-DA-144; AD-661345)

Autooxidation of trimethylborane was studied spectroscopically at temperatures ranging from 77 to 91K. The first detectable species was dimethylboryl methyl peroxide, (CH3)2BOOCH3. Spectroscopic changes which occurred upon standing at 77K, and upon thermal cycling from 77-117K are consistent with reversible formation of a coordination-polymeric species at the lower temperatures. Further work was conducted on the reaction of nitrosonium nitrate with isobutylene. It is suggested that the red color associated with nitrosonium nitrate is attributable to the presence of a small amount of (NO)2(+)NO3(-). Undetectable by low-temperature ESR measurements, the concentration of this species has been affixed as less than 0.001 mole-%. The reaction of tetrafluorohydrazine with iron pentacarbonyl produces an unstable carbonyl compound of the approximate composition Fe(CO)F3. Author (TAB)

N68-13521 Barcelona Univ. (Spain).
THE CHLOROCARBONS. ANTHOLOGY 1
Manuel Ballester et al Wright-Patterson AFB, Ohio ARL Aug. 1967 286 p refs
(Contract AF 61(052)-749)
(ARL-67-0167; AD-661099)

A compilation of reports is presented covering syntheses, mechanisms, reactions, steric distortion, spectra-structure correlation, and other aspects of chlorocarbon chemistry. For individual titles, see N68-13522 through N68-13546.

N68-13522 Barcelona Univ. (Spain).
2,3,4,5 TETRACHLOROPHENYLTRICHLOROMETHANE, A NEW HEPTACHLOROTOLUENE [E1,2,3,4,5 TETRACLOROFENILTRICLOROMETANO, UN NUEVO HEPTACLOROTOLUENO]
Manuel Ballester *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 3–6 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., v. 50B, no. 9–10, Sep.–Oct. 1954 p 765 In SPANISH; ENGLISH summary (See N68-13521 04-06)

It is shown that the new heptachlorotoluene, m.p. 122-3°, obtained by the reaction of Silberrad's chlorinating reagent with phenylchloroform, is the 2,3,4,5,-tetrachlorophenyltrichloromethane. Its structure has been stablished by partial hydrolysis to 2,3,4,5-tetrachlorobenzoic acid by means of concentrated sulfuric acid, at 100°C, and by hydrolyzing nitration to 2,3,4,5-tetrachloro-6-nitrobenzoic acid with fuming nitric acid. The compound failed to give any derivative with chromic anhydride or with silver nitrite. When the chlorination of phenylchloroform is carried out under somewhat more severe conditions formation of some hexachlorobenzene occurs. This is the first reported case of side-chain replacement using Silberrad's chlorinating reagent. Author

N68-13523 Barcelona Univ. (Spain).
HYDROGEN EXCHANGE BETWEEN PERCHLOROTOLUENE AND TOLUENE [TRANSFERENCIAS DE HIDROGENO EN LA REACCION DEL PERCHLOROTOLUENO CON EL TOLUENO]
Manuel Ballester and Carlos Molinet *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 7–12 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., v. 54B, no. 2, Feb. 1958 p 151 In SPANISH; ENGLISH summary (See N68-13521 04-06)

Perchlorotoluene, unlike related highly chlorinated compounds, decomposes at temperatures as low 185°C. Product analysis of the reaction of perchlorotoluene with toluene at 250° in liquid phase has been performed. This has been done to ascertain which is the bond undergoing homolysis as the first step of such decomposition. The major products are hydrogen chloride, benzyltoluene, pentachlorobenzylidene chloride and condensation products, along with minor quantities of pentachlorobenzyl chloride, 2, 3, 4, 5, 6-pentachlorotoluene and bibenzyl. The results are consistent with the occurrence of chlorine–hydrogen exchanges involving chlorinated compounds and toluene followed by condensations of Friedel–Crafts type. Accordingly, it has been shown experimentally that under the conditions of the reaction toluene and benzyl chloride—a postulated major exchange product—yield benzyltoluene. In view that such chlorine–hydrogen exchanges might proceed via a polar mechanism, i.e., hydride ion transfers, it cannot be concluded safely from the results that sidechain carbon–chlorine bond fission in perchlorotoluene is the first step of the thermal decomposition. Author

N68-13524 Barcelona Univ. (Spain). Dept. of Organic Chemistry.
THE POSITIVE HALOGEN REACTION BETWEEN BENZOTRICHLORIDES AND POTASSIUM IODIDE

M. Ballester, C. Molinet, and J. Rosa *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 13–26 refs Repr. from Tetrahedron (N. Ireland), v. 6, 1959 p 109–122 (See N68-13521 04-06)

The "positive halogen" reactions of 2 : 3 : 4 : 5-tetrachlorobenzotrichloride and perchlorotoluene with potassium iodide in aqueous acetic acid, at 100°, have been investigated. In the case of the perchlorotoluene the products are the two isomeric *perchlorostilbenes* along with some 2 : 3 : 4 : 5 : 6-pentachlorobenzylidene chloride. The chief product of the reaction of 2 : 3 : 4 : 5-tetrachlorobenzotrichloride with potassium iodide is α : α : 2 : 3 : 4 : 5 : α′ : α′ : 2′ : 3′ : 4′ : 5′-*dodecachlorobibenzyl;* considerable amounts of the two isomeric α : 2 : 3 : 4 : 5 : α′ : 2′ : 3′ : 4′ : 5′-*decachlorostilbenes* have been isolated. Under the same conditions the α : α : 2 : 3 : 4 : 5 : α′ : α′ : 2′ : 3′ : 4′ : 5′-dodecachlorobibenzyl reacts with potassium iodide to give the corresponding decachlorostilbenes. When the reaction of perchlorotoluene with potassium iodide is performed in aqueous acetic acid containing toluene the yield of 2 : 3 : 4 : 5 : 6-pentachlorobenzylidene chloride is greatly increased and benzyl iodide is formed. The results are consistent with the occurrence of the reaction through the intermediate α : α-dichlorobenzyl radicals and α : α : α′ : α′-tetrachlorobibenzyls, the latter being formed by dimerization of the former. The ultra-violet absorption spectra of the geometric isomers of α : α′-dichlorostibene, α : 2 : 3 : 4 : 5 : α′ : 2′ : 3′ : 4′ : 5′-decachlorostilbene, and perchlorostilbene are recorded and interpreted. The higher-melting isomerides have the *trans* configuration and there exists strong inhibition to resonance in the *trans* forms. Author

N68-13525 Barcelona Univ. (Spain).
SEMIMICRO DETERMINATION OF CHLORINE IN HIGHLY CHLORINATED ORGANIC COMPOUNDS [DETERMINACION SEMIMICRO DE CLORO EN COMPUESTOS ORGANICOS ALTAMENTE CLORADOS]
Manuel Ballester and Juan Riera *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 45–48 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., v. 55B, no. 11, Nov. 1959 p 785 In SPANISH; ENGLISH summary (See N68-13521 04-06)

A semi-micro analytical method for quantitative determination of chlorine in highly chlorinated compounds—where frequently the currently used methods fail is here described. It is essentially analogous to the macro-methods described by Fedoseev and Ivashova, and it consists in the reaction of the chlorinated compound with powdered magnesium at 600°. Author

N68-13526 Barcelona Univ. (Spain).
STERIC INHIBITION OF RESONANCE BY ORTHO CHLORINE ATOMS IN STYRENES AND BENZENE CARBOXYLIC ACIDS. SPECTRAL EVIDENCE [INHIBICION ESTEREA DE LA RESONANCIA POR ATOMOS DE CLORO EN ORTO EN ESTIRENOS Y ACIDOS BENCENOCARBOXILICOS]
M. Ballester, J. Castaner, J. M. Codina, and F. Lluch *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 49–54 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., v. 51B, no. 2, Feb. 1960 p 197 In SPANISH; ENGLISH summary (See N68-13521 04-06)
(Contract AF 61(052)-141)

The ultra-violet spectra of α, β, β, 2, 3, 4, 5-heptachlorostyrene, I, perchlorostyrene, II, 2, 3, 4, 5-tetrachlorobenzoic acid, III, 2, 3, 5, 6-tetrachlorobenzoic acid, IV, pentachlorobenzoic acid, V, 2, 5-dichloroterephthalic acid, VI, and tetrachloroterephthalic acid, VI, are reported and interpreted. Strong steric inhibition of resonance makes the spectra of the derivatives the side chain of which is flanked by two *ortho* chlorine atoms to appear almost, or even quite, indistinguishable from those of chlorinated alkylbenzenes of comparable degree of substitution. Also, it is shown that the inhibition of resonance is somewhat relieved in the mono*ortho* chlorinated derivatives. The spectra of α, β, β, 2, 3, 4, 5-heptachlorostyrene, I, and perchlorostyrene, II, are compared respectively with those of the *trans* forms of α, 2, 3, 4, 5, α′, 2′, 3′, 4′, 5′-decachlorostilbene, IX, and perchlorostilbene, X. Author

N68-13527 Barcelona Univ. (Spain).
THE REACTION OF 2, 3, 5, 6 TETRACHLOROPHENYLTRICHLOROMETHANE WITH IODIDE ION. SPECTRAL STUDY OF THE RESULTING ISOMERIC STILBENES [SOBRE LA REACCION DEL 2, 3, 5, 6-TETRACLOROFENILTRICLOROMETANO CON EL ION IODURO. ESTUDIO ESPECTRAL DE LOS ESTILBENOS ISOMEROS RESULTANTES]
M. Ballester and J. Rosa *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 55–58 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., V. 56B, No. 2, Feb. 1960 p 203 In SPANISH; ENGLISH summary (See N68-13521 04-06)

The positive halogen reaction between 2, 3, 5, 6-tetrachloro-1-trichloromethylbenzene and potassium iodide in acetic acid gives the isomeric *cis*-, I, and *trans*-α, 3, 5, 6, α′, 2′, 3′, 5, 6-decachlorostilbene, II, melting at 231.5–233.0° and 319.5–321.0°, respectively. Ultraviolet light stereomutates I into II. The configurations of the decachlorostilbenes are assigned on the basis of the differences in their ultra-violet spectrum. The α, 2, 3, 5, 6, α′, 2′, 3′, 5′, 6′-decachlorostilbenes have not been reported previously. Author

N68-13528 Barcelona Univ. (Spain).
PREPARATION AND PROPERTIES OF PERCHLORO-P-XYLYLENE [PREPARATION Y PROPIEDADES DEL PERCLORO-P-XILILENO]
Manuel Ballester and Juan Castaner *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 59–62 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B Quim., v. 56B, no. 2, Feb. 1960 p 207 In SPANISH; ENGLISH summary (See N68-13521 04-06)
(Contract AF 61(052)-141)

The positive halogen reaction between perchloro-*p*-xylene and potassium iodide gives an almost quantitative yield of *perchloro-p-xylylene*. Chemical and spectral evidence against the diradical (benzenoid) structure for this chlorocarbon is presented. Author

N68-13529 Barcelona Univ. (Spain).
STERIC HINDRANCE IN THERMAL AND CATALYSED ISOMERIZATIONS OF CHLORINATED α:α-DICHLOROSTILBENES
M. Ballester and J. Rosa *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 63–69 refs Repr. from Tetrahedron (N. Ireland), v. 9, 1960 p 156–162 Presented at the 16th Intern. Congr. of Pure and Appl. Chem., Paris, 1957 (See N68-13521 04-06)

Evidence is given for hindrance to thermal stereomutation of *cis*- and *trans*-perchlorostilbenes. Such hindrance is accounted for in terms of steric inhibition of resonance in the transition state of the isomerization due to the *ortho* chlorine atoms. Also, it is shown that under conditions leading to isomerization in closely related cases, i.e. photochlorination and nuclear perchlorination, the perchlorostilbenes are quite inert. These results are interpreted in terms of steric strain of the reaction intermediates and transition states. Author

N68-13530 Barcelona Univ. (Spain).
ULTRAVIOLET SPECTRA OF SOME POLYCHLORINATED ALKYBENZENES [ESPECTRO ULTRAVIOLETA DE ALGUNOS ALCOHIBENCENOS POLICLORADOS]

M. Ballester, J. Castaner, and E. Guardiola *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 71–76 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., V. 56, No. 7–8, Jul.–Aug. 1960 p 723 In SPANISH; ENGLISH summary (See N68-13521 04-06)

The ultra-violet absorption spectra of 2,3,4,5-tetrachloro-1-pentachloroethylbenzene, 2,3,5,6-tetrachloro-*p*-xylene, 2,3,5,6-tetrachloro-1,4-bischloromethylbenzene, 2,3,5,6-tetrachloro-1,4-bisdichloromethylbenzene, 2,4,6-trichloromesitylene, 1,3,5-tristrichloromethylbenzene and 2,4,6-trichloro-1,3,5-trisdichloromethylbenzene are reported. The data cover the range between 200 mμ and the visible region. The various effects of the substituent on the location and value of the maximum extinction are discussed and interpreted. Author

N68-13531 Barcelona Univ. (Spain).
PREPARATION OF HIGHLY STRAINED AROMATIC CHLOROCARBONS. 1. A POWERFUL NUCLEAR CHLORINATING AGENT. RELEVANT REACTIVITY PHENOMENA TRACEABLE TO MOLECULAR STRAIN

Manuel Ballester, Carlos Molinet, and Juan Castaner *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 77–81 refs Rep. from J. Am. Chem. Soc., v. 82, 1960 p 4254 (See N68-13521 04-06)
(Contract AF 61(052)-141)

The preparation of perchlorotoluene and perchloro-p-xylene is effected starting from 2,3,4,5-tetrachloro-1-trichloromethylbenzene and 1,4-bistrichloromethylbenzene, respectively, by means of a powerful nuclear chlorinating agent. Under the same conditions 1,3,5-tristrichloromethylbenzene is inert. Chlorination of 2,4,6-trichloromesitylene with chlorine and white light gives 2,4,6-trichloro-1,3,5- trisdichloromethylbenzene and products of chlorinolysis; no perchloromesitylene is isolated. Under similar conditions perchlorotoluene and perchloro-p-xylene readily undergo chlorinolysis. Also reported for the first time are 2,3,5,6-tetrachloro-1- trichloromethylbenzene, 2,5-dichloro-1,4-bistrichlorornethylbenzene and 2,3,5,6,-tetrachlorobenzoic acid. Some significant results related to the preparation and stability of those chlorocarbons are explained on the basis of steric strain and distortion. Author

N68-13532 Barcelona Univ. (Spain).
MOLECULAR DISTORTION AND ELECTRONIC SPECTRUM OF AROMATIC COMPOUNDS. 1. CHLORINATED DERIVATIVES OF ALKYLBENZENES

Manuel Ballester and Juan Castaner *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 83–85 refs Repr. from J. Am. Chem. Soc., v. 82, 1960 p 4259 (See N68-13521 04-06)
(Contract AF 61(052)-141)

The absorption electronic spectrum of pentachlorobenzene (I), perchlorobenzene (II), 2, 3, 4, 5, 6-pentachlorotoluene (III), 2, 3, 4, 5, 6-pentachloro -1- chloromethylbenzene (IV), 2, 3, 4, 5, 6-pentachloro -1- dichloromethylbenzene (V), 2, 3, 4, 5-tetrachloro -1- trichloromethylbenzene (VI), 2, 3, 5, 6-tetrachloro -1- trichloromethylbenzene (VII), perchlorotoluene (VIII), perchloroethylbenzene (IX), 1, 4-bistrichloromethylbenzene (X), 2, 5-dichloro-1, 4-bistrichloromethylbenzene (XI), perchloro-*p*-xylene (XII) and pentamethyltrichlorcmethylbenzene (XIII) from 200 mμ to the visible region are reported and discussed. Those compounds having trichloromethyl groups flanked by two *ortho* chlorine atoms show abnormal spectra, consisting chiefly in great bathochromic shifts of some of their bands from their "expected" places, which is accounted for in terms of molecular distortion. Author

N68-13533 Barcelona Univ. (Spain).
SOME NEW CHLORINATED DERIVATIVES DERIVED FROM PROPIOPHENONE [ALGUNOS NUEVOS DERIVADOS CLORADOS A PARTIR DE LA PROPIFENONA]

Manuel Ballester and Juan Riera *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 87–94 refs In SPANISH; ENGLISH summary (See N68-13521 04-06)
(Contract AF 61(052)-141)

Some chlorinated derivatives starting from propiophenone have been prepared and are described for the first time: α, *β-dichloropropiophenone* (II), α, α, β, *β-tetrachloropropylbenzene* (III), α, *β-dichloropropylbenzene* (IV), 1, 1, 2, 2, 3, 4, 5, 6, *7-eneanochloroindan* (V), and α, α, β, β, γ, 2, 3, 4, 5-*eneonochloropropylbenzene* (VII). The characterization of V and VII have been accomplished mainly on the basis of their ultra-violet and infrared-red spectra. The ultraviolet spectrum of perchloroindan is also reported for the first time. It is shown that chlorination of α, β-dichloropropenylbenzene under the nuclear chlorinating conditions described by Ballester can result in side-chain ring closure with the benzene ring. Photochlorination of α, α, β, β, γ, 2, 3, 4, 5-eneanochloropropylbenzene gives also such type of annellation. Also, it is shown that under those chlorinating conditions chlorine addition to ethylene bond, as well as side-chain substitution of hydrogen by chlorine, takes place. Author

N68-13534 Barcelona Univ. (Spain).
PYROLYSIS OF STERICALLY-STRAINED CHLORINATED SUBSTANCES. PERCHLOROTOLUENE AND OH, OH'-DODECACHLOROBIBENZYL [PIROLISIS DE SUSTANCIAS CLORADAS CON TENSION ESTEREA. PERCLOROTOLUENO Y OH, O'H-DODECACLOROBIBENCILO]

M. Ballester, C. Molinet, and J. Rosa *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 95–104 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., v. 57B, no. 5, 1961 p 393 In SPANISH; ENGLISH summary (See N68-13521 04-06)

The thermal decomposition of some sterically strained chlorinated substances begins to occur appreciably at abnormally low temperatures. Here the pyrolisis of perchlorotoluene and that of oH,o'H-dodecachlorobibenzyl are studied. The former gives perchlorobenzene, *perchlorostyrene*, carbon tetrachloride and some *cis-* and *trans*-perchlorostilbene, while the latter yields *cis-* and *trans*-oH,o'H-decachlorostilbene, pentachlorobenzene oH-heptachlorotoluene, *oH-heptachlorostyrene*, carbon tetrachloride and chlorine. Homolytic mechanisms for these reacts are given. They involve the participation of *a,a*-dichlorobenzyl radicals as intermediates, the formation of which is sterically assisted. Author

N68-13535 Barcelona Univ. (Spain).
THE ULTRAVIOLET SPECTRUM OF ALKYL BENZENES. EVIDENCE FOR CARBON–HYDROGEN AND CARBON–CARBON BOND HYPERCONJUGATION (BAKER–NATHAN EFFECTS)

M. Ballester and J. Riera *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 105–115 refs Reprint from Tetrahedron (N. Ireland), v. 20, 1964 p 2217–2227 (See N68-13521 04-06)
(Contract AF 61(052)-141)

By means of the theory of the migration moment of the substituents the absorption of the secondary band ($^1A_{1g} \rightarrow {}^1B_{2u}$ transition) of sixty-seven alkyl benzenes has been studied. The hyperconjugation effects of the carbon–hydrogen and carbon–carbon bonds as well as those of the vibrational and static symmetry perturbations of the benzene nucleus are evaluated. Author

N68-13536 Barcelona Univ. (Spain).
ULTRAVIOLET ABSORPTION INTENSITIES OF THE SECONDARY ($^1A1G \rightarrow {}^1B2U$, ^1LB) BAND OF BENZENE DERIVATIVES IN NON-POLAR SOLVENTS. RELEVANT DATA

Manuel Ballester, Jaime Palau, and Juan Riera *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 117–125 refs Repr. from J. Quant. Spectry. Radiat. Transfer (Gt. Brit.), v. 4, 1964 p 819–827 (See N68-13521 04-06)
(Contract AF 61(052)-141)

The integrated absorptivity and "smoothed" maximum absorptivity of the secondary ($^1A_{1g} \rightarrow {}^1B_{2u}$, ^1L_b) band for over seventy carefully selected benzene derivatives in isooctane or cyclohexane, as well as the linear expression relating them, are given. Author

N68-13537 Barcelona Univ. (Spain).
A STUDY OF THE SYNTHESIS AND PROPERTIES OF ALKAROMATIC CHLOROCARBONS Final Technical Report
Manuel Ballester *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 129–159 refs (See N68-13521 04-06)
(Contract AF 61(052)-141)
(ARL-64-141)

The preparation and study of fifty-five new highly chlorinated compounds, including thirty-one chlorocarbons, four perchloroketones, four perchloroacids and four perchloroesters is reported. The chlorocarbons consist of derivatives of toluene, xylene, styrene, stilbene, p-xylylene, diphenylmethane, biphenyl, anthracene, phenanthren, fluorene, and benzene and biphenyl polymeric chlorocarbons. Author

N68-13538 Barcelona Univ. (Spain).
NEW LINEAR LAW AND EFFECTS RELATING THE ULTRAVIOLET SPECTRA OF SUBSTITUTED BENZENES AND THE MIGRATION (SPECTROSCOPIC) MOMENT
Manuel Ballester, Juan Riera, and Leonard Spialter *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 161–167 refs Repr. from J. Am. (See N68-13521 04-06)
(Contract AF 61(052)-141)

Ultraviolet absorption spectra in the region of 40,000 $cm.^{-1}$ were obtained with high reproducibility (better than 5% precision in molar absorptivity) for more than 100 benzene derivatives. These compounds, ranging from mono- to persubstitution, contained methyl, fluoro, chloro, bromo, iodo, methoxy, trifluoromethyl, chloromethyl, dichloromethyl, trichloromethyl, perchloroethyl, chlorocarbonyl, perchlorovinyl, and/or perchlorostilbyl substituents alone or in combination. The molar absorptivities observed, ranging from 100 to 3000, correlate much better with a here-proposed linear function of the moment obtained by vectorial addition of substituent contributions (of the Sklar "migration moment" type or the Platt "spectroscopic moment" type) rather than the currently accepted "square law." The effect of *ortho* substituents is successfully accounted for in terms of ring distortion and resonance inhibition and leads to the concept of a "constellation migration moment." Author

N68-13539 Barcelona Univ. (Spain).
SYNTHESIS AND PROPERTIES OF ALKAROMATIC CHLOROCARBONS
M. Ballester 30 Nov. 1964 *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 169–186 refs (See N68-13521 04-06)
(Contract AF 61(052)-141)
(ARL-65-161)

The synthesis of twenty-four new chlorinated derivatives of diphenylmethane, fluorene, biphenyl, 1,1-diphenylethane, 1,1-diphenylethylene, acenaphthene, acenaphthylene, triphenylmethane and triptycene is here reported. Among them there are ten chlorocarbons including two anions, one cation and two free radicals. The most outstanding result is the chemical inertness of the chlorocarbon free radicals (perchlorodiphenylmethyl, or PDM, and perchlorotriphenylmethy, or PTM). Author

N68-13540 Barcelona Univ. (Spain).
PERCHLORINATED FREE RADICALS [RADICALES LIBRES PERCHLORADOS]
M. Ballester *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 191–212 refs Repr. from Misc. Barcinonensia, v. 4, 1965 p 19–40 (See N68-13521 04-06)

The discussion covers the synthesis and properties of several new perchlorinated aromatic free radicals, including the perchlorobenzyl radical, the perchloro-3-phenylallyl radical, the perchloro-p-xylylene radical, other radicals derived from chlorides of aromatic carbon bistrichloromethanes, the perchlorodiphenylmethyl radical, and the perchlorotriphenylmethyl radical. Transl. by R.N.A.

N68-13541 Barcelona Univ. (Spain).
AROMATIC AND ALKYLAROMATIC CHLOROCARBONS, SYNTHESES AND PROPERTIES [CHLOROCARBURES AROMATIQUES ET ALCOYLAROMATIQUES. SYNTHESES ET PROPRIETES]
Manuel Ballester *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 217–225 refs Repr. from Extrait Bull. Soc. Chim. (France), no. 1, 1966 p 7 (See N68-13521 04-06)

Methods of preparation and general properties are considered for aromatic and alkylaromatic chlorocarbons, including such compounds as perfluorobenzene and perchlorotoluene and their secondary products. The synthesis of perchloroethyl benzene is described. Free radicals of stable chlorocarbons are discussed, and mention is made of a study of the ultraviolet spectra of benzene chlorocarbons. Transl. by M.W.R.

N68-13542 Barcelona Univ. (Spain).
SYNTHESIS AND PROPERTIES OF ALKAROMATIC CHLOROCARBONS Scientific Report, 1 Nov. 1964–31 Oct. 1965
M. Ballester Apr. 1966 *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 227–244 (See N68-13521 04-06)
(ARL-66-0070)

Progress in the alkaromatic chlorocarbons is summarized, including informational exchanges, papers presented and published, and patent history. Recent data obtained from the synthesis and reactivity studies on the new class of inert perchlorocarbon free radicals are described. These include results obtained with perchlorodiphenylmethyl, perchlorotriphenylmethyl, perchloro-4-phenyldiphenylmethyl, perchloro-4-phenyltriphenylmethyl, perchloro-$\alpha,\alpha,\alpha',\alpha'$,-tetraphenylbi-p-tolyl- α,α'-ylene diradical, αH,αH, αH-tetradecachloro-4-methyltriphenylmethyl radicals, and related compounds. These radicals are chemically inert to oxygen and halogens, due principally to steric hindrance, but give sharp electron spin resonance lines. Author

N68-13543 Barcelona Univ. (Spain).
PHOTOLYSIS OF PERCHLOROTOLUENE. SYNTHESIS OF PERCHLOROETHYLBENZENE AND RELATED SUBSTANCES [FOTOLISIS DEL PERCLOROTOLUENO. OBTENCION DEL PERCLOROETILBENCENO Y DE SUSTANCIAS AFINES]
Manuel Ballester and Juan Castaner *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 245–256 refs Repr. from Ann. Real Soc. Espan. Fis. Quim., Ser. B. Quim., v. 62, no. 4–5, Apr–May 1966 p 397

The photolysis of perchlorotoluene in carbon tetrachloride gives a mixture containing *perchlorocthylbenzene*, perchlorobenzene, *cis*- and *trans*-perchlorostilbene, and perchlorostyrene. The primary step of this reaction is the homolysis of a trichloromethyl carbon–chlorine bond giving the perchlorobenzyl radical. This radical accounts for all the reaction products. The nuclear chlorination of α,β,β-trichlorostyrene with the BMC agent as well as the chemical

behaviour of the products, are studied. Some aspects of the reactivity of the perchloroethylbenzene, its ultraviolet and infrared spectrum, and its steric strain and molecular distortion are also discussed. Author

N68-13544 Barcelona Univ. (Spain).
SYNTHESIS, STRUCTURE, AND CONFIGURATION OF SOME MACROMOLECULAR CHLOROCARBONS OF HIGH THERMAL AND CHEMICAL STABILITY
Manuel Ballester, Juan Castaner, and Juan Riera *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 257–263 refs (See N68-13521 04-06)
(Contract AF 61(052)-141)

The syntheses of three macromolecular chlorocarbons [perchloropoly-p-xylenediylidene (PP-xynene), $(C_8Cl_6)_m$; perchloropoly-p-dipropenylbenzenediylidene (PP-diprobene), $(C_{12}Cl_{10})_m$; and perchloropolybi-p-tolyldiylidene (PP-bitylene), $(C_{14}Cl_{10})_m$] starting from perchloro-p-xylene, perchloro-1,4-dipropenylbenzenes, and perchlorobi-p-tolyl, respectively, are described and their structure and configuration studied. The mechanism of this polycondensation is discussed. These materials have an exceptionally high thermal stability (up to 500°, incipient red heat) and chemical inertness. Author

N68-13545 Barcelona Univ. (Spain).
INERT CARBON FREE RADICALS
Manuel Ballester *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 265–267 (See N68-13521 04-06)

The first free radical detected, the triphenylmethyl, is described followed by details on the steric difficulties, properties, and synthesis of various aromatic and alkaromatic chlorocarbon radicals. Emphasis is given to the perchlorodiphenylmethyl and perchlorotriphenylmethyl radicals and their related compounds. R.N.A.

N68-13546 Barcelona Univ. (Spain).
BAND RE-ASSIGNMENT FOR ANILINE AND ITS DERIVATIVES. THE MIGRATION (SPECTROSCOPIC) MOMENT OF THE AMINO GROUPS
M. Ballester and J. Riera *In its* The Chlorocarbons. Anthology 1 Aug. 1967 p 269–275 refs Repr. from Spectrochim. Acta (N. Ireland), v. 23A, 1967 p 1533–1539 (See N68-13521 04-06)
(Contract AF 61(052)-141)

Evidence showing that the "300 mμ" or D band of aniline and its derivatives is due to the $^1A_{1g} \rightarrow {}^1B_{2u}$, ^1L_b transition (seconday band) and ruling out an alternative, current assignment is presented. The *ortho* effects upon the intensity of this band are studied. The effect of steric inhibition of resonance upon the migration (spectroscopic) moment of amino groups is presented. Author

N68-13551*# National Aeronautics and Space Administration, Washington, D. C.
SOME CONSIDERATIONS ON THE STRUCTURE AND RADIATION CHEMISTRY OF WATER
Robert Schiller and Istvan Kiss Dec. 1967 10 p refs Transl. into ENGLISH from Mag. Tudo. Akad. Kozp. Fiz. Kutato Intezetenek Kozlemen, v. 11, 1963 p 175–183
(NASA-TT-F-11368) CFSTI: HC $3.00/MF $0.65 CSCL 07E

The variation in the yield of radiolytic products with higher ranges of concentration and with the temperature unexplained as yet by the radical diffusion theory is discussed. It is shown that by considering some structural features of water, both the temperature dependence of the radical yield and the concentration dependence of H_2 production in the entire range of concentration can be interpreted. The results predicted from the relationships thus established agree to orders of magnitude with the measured temperature coefficients of radical yields. Finally some problems concerning the scope of the radical diffusion model are considered. Author

N68-13554# Explosives Research and Development Establishment, Waltham Abbey (England).
THE GROWTH OF WHISKERS FROM THE VAPOUR PHASE
T. J. Lewis 6 Jan. 1966 53 p refs
(ERDE-17/M/66; AD-661496)

The factors influencing the growth of whiskers from the vapour are reviewed. Reactions are classified as either physical or chemical, the latter being subdivided as homogeneous or heterogeneous. The stages of growth are taken to be (i) nucleation, arguments being presented that this is normally a surface process, (ii) growth from the nuclei, critical analyses being made of the screw-dislocation and VLS mechanisms, and of the supersaturation criteria for the physical growth process, and (iii) termination, about which little is known, but which may be due to dislocation movement or surface poisoning. Metallic and ceramic whiskers resulting from chemical reactions are reviewed, and the E.R.D.E. process for the growth of silicon nitride analysed. Thermodynamic and kinetic criteria for the chemical reaction taking place at the whisker tip are suggested, these criteria being regarded as the chemical analogue to the supersaturation conditions for the physical growth process. Author (TAB)

N68-13640 Ghent Univ. (Belgium).
THE DETERMINATION OF OXYGEN IN METALS BY 14 MEV NEUTRON ACTIVATION ANALYSIS
J. Hoste, D. DeSoete, and A. Speecke Brussels EURATOM Sep. 1967 76 p refs
(Euratom-028-64-9 IRAB)
(EUR-3565.E)

An automated oxygen analysis system for steel samples is elaborated, where with 14 MeV neutrons from a neutron generator is elaborated, where with 14 MeV neutrons from a neutron generator the reaction $^{16}O(n,p)^{16}N$ ($T_{1/2}$ = 7.4 s) is used. A fast double pneumatic transport system for rectangular 18 g samples has been constructed, which allows the standard to be activated at the same time as and behind the sample. The ^{16}N γ-activities are measured above 4.5 MeV with two separated counting systems. Interferences from B and F are given. Sensitivity of the method is approx. 0.1 mg oxygen at maximum neutron output. Correlation between activation and reducing fusion results has been extensively studied on numerous samples of different origin, and is excellent. The complete activation analysis apparatus for 38 g disk samples has been industrialized in a steel work. As an extension to the steel analysis the oxygen determination in 11 different non-ferrous metals, Al, Bi, Cd, Co, Cu, Nb, Pb, Ta, Ti, Zn and Zr has been studied. Possible matrix effects on the oxygen standards were investigated and found to be negligible. Author

N68-13746# Iowa State Univ. of Science and Technology, Ames.
KINETICS AND MECHANISMS OF REACTIONS OF CYANOCOBALT AND -CHROMIUM COMPLEXES IN ACIDIC SOLUTION
James Peter Birk (Ph.D. Thesis) May 1967 144 p refs
(Contract W-7405-ENG-82)
(IS-T-142) CFSTI: HC $3.00/MF $0.65

The immediate product of the reaction of Cr^{2+} with the Co(III) complexes $Co(NH_3)_5CN^{2+}$, trans-$Co(NH_3)_4(H_2O)CN^{2+}$ and trans-$Co(en)_2(H_2O)CN^{2+}$, is a metastable intermediate that decays to for $CrCN^{2+}$. On the basis of kinetic behavior (which was independent of the source of intermediate), spectra, and ^{51}Cr tracer experiments, the intermediate was postulated to be the linkage isomer $CrNC^{2+}$ in rapid equilibrium with $CrNCH^{3+}$. The isomerization of $CrNC^{2+}$ followed pseudo-first-order kinetics. The

mechanism proposed for the reaction is given. The aquation of $CrCN^{2+}$ followed pseudo-first-order kinetics, with the observed rate constant dependent on $[H^+]$: $k_{obs}=k_{-1}[H^+]^{-1}+k_0+k_1[H^+]$. Probable configurations of the transition states were proposed on the basis of entropy correlations. In solutions of low $[H^+]$, the aquation is catalyzed by Cr^{2+}, probably by a hydroxide-bridge electron transfer mechanism. Mercury(II) forms an extremely stable complex with $CrCN^{2+}$, presumably $CrCNHg^{4+}$, which aquates more rapidly than does $CrCN^{2+}$ for $[H^+] \leq 0.7$M. The electron exchange reaction of Cr^{2+} with $CrCN^{2+}$ was investigated. Contrary to studies of most other Cr^{2+}–Cr(III) exchange reactions, the second-order rate constant was dependent on $[H^+]$: $k_{ex}=k_0+k_{-1}[H^+]^{-1}$. Reactions of Cr^{2+} with the higher cyano complexes cis-$Cr(CN)_2^+$, 1, 2, 3-$Cr(CN)_3$ and cis-$Co(en)_2(CN)_2^+$ also produced an intermediate. The decay of the intermediates, not investigated in detail, was in each case slower than the isomerization of $CrNC^{2+}$. Author (NSA)

N68-13752# Iowa State Univ. of Science and Technology, Ames.
DIFFUSION OF CARBON, NITROGEN, AND OXYGEN IN BETA THORIUM
Thomas George Carnahan (M.S. Thesis) Aug. 1967 36 p refs
(Contract W-7405-ENG-82)
(IS-T-189) CFSTI: HC $3.00/MF $0.65

The diffusion coefficients of C, N_2, and O_2 were determined in β Th over the temperature range 1435 to 1715°C. Beta Th has the body centered cubic structure. Values for the activation energies were found to be 27±3 kcal/mole for C, 17±4 kcal/mole for N_2, and 11±4 kcal/mole for O_2 diffusion. The frequency factors, D_0, were found to be 0.02±0.01 cm^2/sec for C, 0.003±0.002 cm^2/sec for N_2, and 0.001±0.003 cm^2/sec for O_2 diffusion. The experimental method was a diffusion couple technique. Also, C was found to harden annealed Th nearly linearly with concentration over the range 100 to 1000 ppM C. Author (NSA)

N68-13753# Iowa State Univ. of Science and Technology, Ames.
THE CRYSTAL STRUCTURE DETERMINATIONS OF $OP(OCH_2)_3CCH_3$ AND A HYDROLYSIS PRODUCT OF $PO_3C_8H_9$
Dale Meyers Nimrod (Ph.D. Thesis) Aug. 1967 96 p refs
(Contract W-7405-ENG-82)
(IS-T-183) CFSTI: HC $3.00/MF $0.65

The crystal structure determinations of the bicyclic phosphate, $OP(OCH_2)_3CCH_3$ (1-oxo-4-methyl-2,6,7-trioxa-1-phosphabicyclo [2.2.2]octane) and of one of the isomers formed in the hydrolysis of 2,8,9-trioxa-1-phosphaadamantane, (3-α-oxo-3-β-hydroxy-2, 4-dioxa-3-phosphabicyclo[3.3.1]nonane are reported. Three dimensional X-ray diffraction counter data were obtained and refined by full matrix least-squares and Fourier techniques. Crystals of $OP(OCH_2)_3CCH_3$ were orthorhombic, space group $Pmc2_1$, with unit cell dimensions 6.74 × 5.96 × 17.77 A, four molecules per unit cell. The results suggest that some strain is probably present in the bicyclic structure. The bonding of the oxygens to the phosphorus appeared to be similar to that found in other trialkyl phosphates whose structures are known. The terminal O=P bond distance was 1.46±.02 A, and the bridging P–O distances averaged 1.57±.02 A. The O=P–O angle was 115.0±1.1°, and the O–P–O angle was 103.7±.6°. The hydrolysis product, $PO_4C_8H_{11}$, crystallized in space group $P2_12_12_1$ with unit cell dimensions 5.84×11.67×10.91 A with four molecules per unit cell. The conformation of the isomer, predicted earlier on the basis of infrared and proton nmr spectral evidence, was fully confirmed. The conformational stability and the mechanism of the hydrolysis reaction are discussed. The tuning of a general reflection on a computer-automated X-ray diffractometer is discussed. The mathematical expressions for simplifying the mechanical movements are developed. Author (NSA)

N68-13766 Joint Publications Research Service, Washington, D. C.
CHEMISTRY OF HETEROCYCLIC COMPOUNDS
14 Dec. 1967 11 p refs Transl. into ENGLISH from Khim. Geterotsikl. Soyedineniy (Riga), no. 4, 1967 p 577–768
(JPRS-43714) CFSTI: $3.00

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N68-13767 Joint Publications Research Service, Washington, D. C.
ESTERS OF PHOSPHORIC AND THIOPHOSPHORIC ACIDS WITH SOME DERIVATIVES OF AZOLES
B. A. Arbuzov, A. R. Vil'chinskaya, and M. G. Belyayeva *In its* Chem. of Heterocyclic Compds. 14 Dec. 1967 p 1–5 refs (See N68-13766 04-06)

When spiro (cyclohexane-1,2'–oxazolidine) was interacted with monochlor-anhydrides of phosphoric and thiophosphoric acids, the corresponding esters were obtained. We were unable to obtain derivatives with dispiro (cyclohexane-1,2'–oxazolidine) radicals. When 2-thio-5,5-dimethyloxazolide-4-one reacted with chloranhydride of a diethyl ester of phosphoric acid, an alkylation product was obtained. 5,5-dimethylhydantoin did not react with phosphoryl chlorides under the conditions of the conducted experiments. Author

N68-13768 Joint Publications Research Service, Washington, D. C.
ON SOME REACTION PRODUCTS OF PHENYLHYDRAZONES WITH TRICHLORINATED PHOSPHORUS
N. P. Ignatova, N. N. Mel'nikov, and N. I. Shvetsov-Shilovskiy *In its* Chem. of Heterocyclic Compds. 14 Dec. 1967 p 6–10 refs (See N68-13766 04-06)

It was established that when phosphorus trichloride interacts with phenylhydrazones of acetone, methyl ethyl ketones, methyl propyl ketones and methyl butyl ketones, compounds are formed which contain one radical of phenylhydrazone per one phosphorus atom. These compounds can be distilled in vacuum and do not contain any chlorine. A structural formula is suggested. An analogous substance has also been isolated in a reaction of trichlorinated phosphorus with a phenylhydrazone of acetaldehyde. Author

N68-13778*# General American Transportation Corp., Niles, Ill. Research Div.
RESEARCH AND DEVELOPMENT STUDY RELATED TO THE SYNTHESIS OF FORMALDEHYDE FROM CO_2 AND H_2 Quarterly Progress Report, Aug.–Oct. 1967
P. Budininkas and G. A. Remus Oct. 1967 13 p
(Contract NAS2-3889)
(NASA-CR-73070-5; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Activities concerned with (1) oxidation of methane to formaldehyde by air using a gaseous nitric oxide catalyst in conjunction with various solid, heated reaction beds in a single pass reactor, (2) preliminary testing of a recycle system using nitric oxide catalyst, and (3) oxidation of methane to formaldehyde with ozonized air or oxygen in the heated potassium tetraborate reaction bed, are summarized.

N68-13798* Pennsylvania State Univ., University Park. Materials Research Lab.
RESEARCH ON THE MECHANISM AND KINETICS OF OXIDATION OF SILICON IN AIR Semiannual Report, 1 Jun.–30 Nov. 1967
K. Vedam, F. Lukes, and Wulfhart Knausenberger 12 Dec. 1967 32 p refs
(Grant NGR-39-009-042)
(NASA-CR-91509; SAR-5) CFSTI: $3.00 CSCL 07B

A new method has been developed for determining the fundamental optical constants (n and k) of any isotropic absorbing material, even though the surface of the material may be covered with a thin oxide or other contaminant film. Furthermore by this method it is also possible to obtain the refractive index n_1 and the thickness d_1 of the contaminant film at the same time. This new method is based on the important fact that the reflectivity of any material with a contaminant film $\leq$200Å is nearly constant and equal to that of the film free surface and further the experimentally observed values of the ellipticity parameters Δ and Ψ at various angles of incidence above and below the principal angle of incidence can be explained only by an unique combination of the values n, k, n_1 and d_1. Preliminary measurements on single crystals of silicon indicate that its refractive index is not constant but can have a value between 4.00 and 4.18 for λ5461Å depending on the history of the sample. Author

N68-13799 Akademiya Nauk SSSR, Novosibirsk.
THE INFLUENCE OF SHOCK COMPRESSION ON THE CATALYTIC PROPERTIES OF OXIDE SEMI-CONDUCTOR CATALYSTS
G. Boreskov, I. Sazonova, N. Keyer, V. Kudinov, G. Gridasova et al [1967] 11 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

The catalytic activities of oxide catalysts of P- (NiO) and N- (TiO_2, $BaTiO_3$, ZnO) types of conductivity in reaction to CO oxidation were studied. Solid solutions of TiO_2 with WO_3 and Fe_2O_3 and of $BaTiO_3$ with La_2O_3 as well as pure oxides were used. In all cases the kinetic equation of state was of the first order and the rate constants were determined by the duration of 50% conversion. The activation energies and pre-exponential factors were calculated by using the Arrhenius expression. It was found that the catalytic activity of oxide catalysts of N-type conductivity increased sharply, and that of P-type semiconductors did not change at all after shock loading. G.G.

N68-13836# IIT Research Inst., Chicago, Ill. Technology Div.
ADVANCED OXIDIZER CHEMISTRY Technical Summary Report, Apr. 1–Jun. 30, 1967
Irvine J. Solomon 11 Sep. 1967 28 p refs
(Contract AF 49(638)-1175)
(IITRI-C227-20; AFOSR-67-2645; AD-661583)

Work on the structure of dioxygenyl fluoroborate is nearing completion. Raman spectral data, and F18 tracer studies, are consistant with the O2(+) Structure. Decomposition kinetics point to an OOF intermediate in the decomposition of O2BF4. It was also found that dioxygenyl fluoborate can be prepared by two new and interesting photochemical reactions: the reaction of oxygen, fluorine and boron trifluoride and the reaction of oxygen difluoride and boron trifluoride. Tracer techniques have shown that the reaction of O2F2 with SO2 proceeds via an OOF intermediate. This work is now complete and all the O17 NMR data is presented. The OOF group was also transferred to carbon in that at least two OOF compounds are prepared by the reaction of either O2F2 or O4F2 with perfluoropropylene. Author (TAB)

N68-13881*# General American Transportation Corp., Niles, Ill. Research Div.
RESEARCH AND DEVELOPMENT STUDY RELATED TO THE SYNTHESIS OF FORMALDEHYDE FROM CO_2 AND H_2 Quarterly Progress Report, May–Jul. 1967
P. Budininkas, R. W. Ferris, and G. A. Remus Jul. 1967 15 p
(Contract NAS2-3889)
(NASA-CR-73070-4; QPR-4) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Oxidation of methane to formaldehyde was studied with nitrogen oxide catalysts in the presence of alkali tetraborates, as well as with ozonized air in the presence of metal salts and potassium tetraborate catalysts. Experiments were also conducted to determine the feasibility of separating the formaldehyde from other reaction products and forming a solid paraformaldehyde. Highest formaldehyde yields were between 2.25% and 3.0%, depending upon catalysts and feed mixture contents. Total absolute amounts of formaldehyde produced reach their maxima with 60% methane–40% oxygen and 35% methane–65% air feed mixtures. With a single pass reactor containing a 40 cm^3 reaction bed, formaldehyde production with air-methane feeds reaches 54 g/day using a space velocity of 7500 hr^{-1}. M.W.R.

N68-13887*# General American Transportation Corp., Niles, Ill. Research Div.
RESEARCH AND DEVELOPMENT STUDY RELATED TO THE SYNTHESIS OF FORMALDEHYDE FROM CO_2 AND H_2 Quarterly Progress Report, Feb.–Apr. 1967
P. Budininkas, R. W. Ferris and G. A. Remus Apr. 1967 17 p refs
(Contract NAS2-3889)
(NASA-CR-73070-3; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Oxidation of methane to formaldehyde was accomplished by using nitrogen oxide gaseous catalysts alone and in the presence of alkali tetraborates, as well as by using ozonized oxygen in the presence of barium peroxide promoted by either a silver oxide catalyst or a nickel–tungsten catalyst. A literature survey and study were made relating to the production of methanol from carbon dioxide under atmospheric pressure. Highest formaldehyde yields obtained from oxidation in the presence of gaseous nitrogen oxide catalysts were 1.35% in single pass reactors and 6.4% in a recycle system, based on methane in the feed gas. Reaction zones of these reactors were filled with 6 mm porcelain Berl saddles coated with potassium tetraborate. Empty reactors, even when coated with potassium tetraborate, produced only up to 0.9% formaldehyde. Only trace amounts of formaldehyde were obtained by the oxidation of methane with ozonized oxygen in the presence of a catalyst consisting of BaO_2 activated with 0.5% Ag_2O and 1% Na_2O_2. Using a nickel–tungsten catalyst produced a 0.3% yield. M.W.R.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-12878*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APOLLO C-BAND RADAR TRACKING CAPABILITY
P. E. Schmid 15 Sep. 1967 19 p refs
(NASA-TM-X-63049; X-551-67-503) CFSTI: HC $3.00/MF $0.65 CSCL 17I

The purpose of this report is to document the current (1967) tracking capability of the Apollo land and ship based C-band radar equipment. This documentation is in support of the Apollo Navigation Working Group task of periodically updating the information contained in Technical Report AN-1 "Apollo Mission and Navigation System Characteristics", a joint Goddard Space Flight Center–Manned Spacecraft Center publication. Author

N68-12908*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TESTS OF HYPOTHESES AND ESTIMATION OF THE CORRELATION COEFFICIENT USING SIX AND EIGHT QUANTILES
Isidore Eisenberger 1 Jan. 1968 49 p refs
(Contract NAS7-100)
(NASA-CR-91376; JPL-TR-32-1163) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Previous results obtained from the investigation of quantiles for data compression of space telemetry are presented. Tests of hypotheses are given, using six and eight optimum sample quantiles. Tests A and $\bar{A}$ test the mean of a normal population. In Test A the variance is assumed to be known and in Test $\bar{A}$ it is assumed to be unknown. Test B tests the variance of a normal population when the mean is unknown. Tests D and $\bar{D}$ decide whether the unknown means of two independent normal populations are identical under different assumptions on the values of the parameters. Test $\bar{E}$ decides whether the unknown variances of two independent normal populations are identical when their common mean is unknown. Tests F and $\bar{F}$ decide whether or not two normal populations are independent. In addition, estimators of the correlation coefficient are constructed. Suboptimum test statistics and estimators are also given. In all cases, the sample sizes are assumed to be large. Author

N68-12936*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIO FREQUENCY INTERFERENCE PREDICTION PROGRAM FOR EARTH-ORBITING SATELLITES
Ralph E. Taylor Oct. 1967 24 p refs
(NASA-TM-X-63050; X-523-67-508) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Satellite orbits can be determined at least one week ahead; therefore, an a-priori RFI prediction can be made that permits re-scheduling of station operations during restrictive periods when RFI is present. A computer-controlled satellite RFI prediction technique, employing the UNIVAC 1108 digital computer, has been developed that predicts interference one-week in advance for up to 50 satellites and 50 stations. Computer inputs for the satellites include center frequency, spectral bandwidth, radiated power level, and Brouwer Mean elements for orbit determination. Tracking station inputs include antenna radiation patterns, both mainlobe and sidelobes, that are segmented in one-degree increments. Satellite-orbit data points, and station-received satellite signal-to-interference ratios, are computed at two-minute intervals. Station RFI reports show good agreement with predictions. Author

N68-12988 Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FOR THE MONTH OF MAY 1967
May 1967 42 p

Tabulated data of satellite observations are presented. The observations include time (U.T.), right ascension, declination, and magnitude. N.E.N.

N68-12990* Allied Research Associates, Inc., Boston, Mass.
NASA/ESSA WEFAX EXPERIMENT EVALUATION REPORT (ATS-1)
1967 42 p
(Contract NAS5-10204)
(NASA-CR-91360) CFSTI: $3.00 CSCL 17B

Weather facsimile transmissions are evaluated to determine the feasibility of disseminating meteorological data and satellite cloud camera pictures for a central weather station source to widely scattered remote weather stations or receiving units. From the ground station, the charts and pictures are transmitted to the ATS-1 for relay via the VHF transponder in the spacecraft to all participating automatic picture transmission (APT) stations. Based on over 11,800 weather chart receptions, it was concluded that weather charts can be transmitted to widely scattered receiving stations with acquisition angles even as low as 3°. An evaluation of over 10,700 satellite picture receptions, showed that satellite cloud cover pictures can be retransmitted from a central source through an earth synchronous satellite to the weather stations. To obtain quality reception, the pictures should be transmitted from digital data. Nearly 70% of both receptions were classified as good or excellent by all stations. M.G.J.

N68-13029# Michigan State Univ., East Lansing. Engineering Research Div.
REDUCTION OF BACKSCATTERING FROM THE INFINITE CONE AND THE SPHERE BY IMPEDANCE LOADING
C. K. Dudley and K. M. Chen 1 Jul. 1967 153 p refs
(Contract AF 19(628)-5732)
(SR-4; AFCRL-67-0490; AD-661528)

The theoretical study on the reduction of the backscattering of the infinite cone and the sphere by the impedance loading method is presented. An infinite cone is assumed to be illuminated by a plane wave at the nose-on incidence. The backscattering of the cone is minimized by loading the cone surface with (1) a circumferential slot backed by an impedance, (2) a radial slot backed by an impedance and (3) a patch impedance. The sphere is given a similar treatment with the impedance area being in the shape of the wedge and the patch. For both the infinite cone and the sphere, it is shown that the optimum impedance for each case can be found to make the backscattering vanish. Author (TAB)

N68-13044*# Advanced Technology Corp., Timonium, Md.
STUDY PROGRAM ON (30–100 GHZ) ELECTRONICALLY STEERABLE ANTENNA SYSTEMS Quarterly Report, 20 Apr.–20 Jul. 1967
John M. Cotton, Jr. 20 Jul. 1967 37 p ref
(Contract NAS5-10256)
(NASA-CR-91383; QR-4) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Electronically steerable antenna elements were fabricated, and possible mutual coupling effects were investigated. Far field patterns were computed for antenna output arrays. The component parts of a compact series feed arrangement were tested, and the complete design was established. Phase transfer characteristics of varactor harmonic generators were studied to determine problems involved with phase control at the sub-harmonic of the transmitter frequency. L.S.

N68-13052# Syracuse Univ. Research Corp., N. Y. Defense Systems Div.
A STATISTICAL ANALYSIS OF SITING ERROR IN RADIO DIRECTION-FINDING Interim Report
Laurence A. Lyons (Ph.D. Thesis) 30 Aug. 1967 146 p refs
(Contract Nonr-4798(00))
(DSD-R-161; AD-661341)

A statistical model was developed for a direction-finding site at HF (1 - 30 MHz). The model was used to analyze the effects of extended re-radiators on D/F accuracy and was examined both theoretically and experimentally. An explicit expression is obtained for the probability density distribution of the electric field amplitude as a function of each of two quantities; azimuthal position of the transmitter and transmitter frequency. The distribution is shown to be a one-parameter Rice distribution in each case. The parameter may be obtained by sampling over either azimuthal angle or frequency. It is suggested that this parameter be used as a single-number criterion for the evaluation of D/F sites.
Author (TAB)

N68-13088 Royal Aircraft Establishment, Farnborough (England).
A THEORY FOR THE DESIGN AND ANALYSIS OF RADIO INTERFERENCE SUPPRESSORS
W. R. Hinton, C. A. Meadows, and L. C. Caddy Dec. 1966 28 p refs
(RAE-TR-66391)

Conventional electric wave filter theory does not allow performance to be predicted unless the external impedances terminating the filter are known. A method is offered whereby the voltage attenuation during transmission can be predicted, or arranged by design, to exceed a certain minimum value whatever the value of the terminating load impedance. This theory applies to both the pass and stop band of frequency. Author

N68-13093# Mitre Corp., Bedford, Mass.
NRD INTRA-STATION DATA TRANSMISSION ENGINEERING
Otto Cardinale and Walter J. Ciesluk, Jr. Sep. 1967 66 p refs
(Contract AF 19(628)-5165)
(MTR-409; ESD-TR-67-361; AD-662002)

Methods for transferring digital data between remote subscribers and Range Communications Control Centers within NRD sites are reviewed and baseband data transmission techniques for this purpose are examined in detail. First, the factors which influence baseband data transmission in existing NRD intra-site cable pairs are discussed. Next, a test program, which was designed to measure the transmission characteristics and the error rate performance of some simple baseband data techniques over these cable pairs, is described and the results are presented, analyzed, and interpreted. Finally, the elements which require special consideration in the design of efficient, cost effective baseband systems for intra-station data transmission are stressed and some implementation suggestions are presented. Author (TAB)

N68-13114# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR THE PROPAGATION OF A FLAT WAVE OVER A CONDUCTING SURFACE [USTROYSTVO DLYA IMITATSII RASPROSTRANENIYA PLOSKOY VOLNY NAD PROVODYASHCHEY PROVERKHNOST'YU]
M. Ya. Gil'chenok and Ye. G. Pashchenko 2 Jun. 1967 8 p Transl. into ENGLISH from Russian Patent No. 169593 (Appl. No. 903041/26-9, 3 Jun. 1964) 2 p
(FTD-HT-66-679; AD-661768)

A device is described for the imitation of the propagation of a flat wave over a conducting surface which consists of a generator and strip lines. For the purpose of assuring the imitation and change in the parameters of the electromagnetic field which is being propagated over any conducting surface, including earth and water, it is designed in the form of three intersecting strip lines loaded at one end by wave resistances, while two of the lines are fed in counterphase fashion through a phase converter and an attenuator, while the third is supplied directly from the common generator. TAB

N68-13161* ITT Federal Labs., Nutley, N. J.
TIME DIVISION MULTIPLE ACCESS (TDMA) SYSTEM, PHASE 1 Final Report
Jun. 1967 271 p
(Contract NAS5-10123)
(NASA-CR-91405; TC-C67-57) CFSTI: $3.00 CSCL 17G

Synchronization equipment for a time division multiple access (TDMA) system for use with a medium altitude satellite and a relatively small ground station is described; specifically, this equipment will be used in a feasibility experiment with the Relay II satellite. A Doppler compensation technique is used by the TDMA, whereby the master station does active tracking and the other stations passive tracking, and the first order Doppler shift on the sync signal of the satellite is removed. A theoretical analysis of the residual frequency error on the satellite timing due to the second order Doppler effects is included, and other sources of timing error are considered. A detailed description of the TDMA terminal and its major functional units, and the various circuit modules used in the equipment are also described. An analysis of the effect of propagation delay on PLL noise bandwidth is presented, and an experiment to determine the nonlinear signal suppression characteristics of the Relay satellite's transponder is summarized.
M.W.R.

N68-13209# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE LINCOLN EXPERIMENTAL TERMINAL
J. W. Craig, W. R. Crowther, P. R. Drouilhet, Jr., J. N. Harris, F. E. Heart et al 21 Mar. 1967 113 p refs
(Contract AF 19(628)-5167)
(ESD-TR-67-182; TR-431; AD-661577)

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3. MODULATION AND DEMODULATION SYSTEM B. H. Hutchinson, S. B. Russell, and J. W. Craig p 33–56 refs (See N68-13212 04-07)
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5. A SEQUENTIAL DECODING TECHNIQUE AND ITS REALIZATION IN THE LET I. L. Lebow and P. G. McHugh p 77–101 refs (See N68-13214 04-07)
6. CHANNEL VOCODER J. Tierney and J. N. Harris p 103–112 refs (See N68-13215 04-07)

N68-13210# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LINCOLN EXPERIMENTAL TERMINAL
B. E. Nichols and P. Rosen *In its* The Lincoln Exptl. Terminal 21 Mar. 1967 p 1–17 refs (See N68-13209 04-07)

The Lincoln Experimental Terminal (LET) is a complete, self-contained air-transportable ground terminal for testing and demonstrating evolving space communications techniques in a realistic environment. Its present equipment complement permits efficient, highly reliable, multiplexed digital communication of voice

and record traffic with a variety of channels, including the moon and active satellites. Its modulation system, using a 16-symbol alphabet frequency-hopped over a 20-MHz band, together with efficient coding, provides multiple access to a wide-band satellite. Author

N68-13211# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SIGNAL PROCESSING SYSTEM
P. R. Drouilhet, Jr. *In its* The Lincoln Exptl. Terminal 21 Mar. 1967 p 19–31 refs (See N68-13209 04-07)

A transportable satellite communications terminal has been built to embody several recent developments. The modulation and coding system in the LET permits operation at low received signal-to-noise ratio with both dispersive (e.g., the moon) and nondispersive (e.g., active repeater) satellite communications media. Frequency hopping of a 16-ary signaling alphabet plus sequential coding and decoding matched to this modulation format provide a high degree of interference rejection and an erasure probability of less than 10^{-3} at an E/N_0 of approximately 6 dB on a nonfading channel, 10 dB on a fading channel. Three data rates are provided: 9600 bits/s to accommodate a voice-excited vocoder permitting "phone-patch" operation; 4800 bits/s, to accommodate a pitch-excited vocoder requiring high quality input speech; and 200 bits/s for teletype only. Two teletype channels are multiplexed with each of the higher rates. Terminal control functions, are preformed by a Univac 1218 computer. Author

N68-13212# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MODULATION AND DEMODULATION SYSTEM
B. H. Hutchinson, S. B. Russell, and J. W. Craig *In its* The Lincoln Exptl. Terminal 21 Mar. 1967 p 33–56 refs (See N68-13209 04-07)

A bandspread modulation–demodulation system employing frequency hopping was designed for use with a sequential decoder to provide high efficiency (6 dB required E_b/N_0, nonfading) and substantial protection against multipath and interference on active or passive satellite communications channels. Three complete systems were built and demonstrated as part of the Lincoln Experimental Terminal (LET) program. Key components include: a digitally controlled frequency synthesizer capable of selecting one of 32,768 frequencies in a 20-MHz band with a worst-case switching delay of 10 μs; a bandpass crystal filter which closely approximates an ideal matched filter for the 200-μs pulsed-sinusoid channel signal used; and a 16-symbol "ordered list" signal processor of novel design. The feasibility and attractiveness of a broad class of communications systems using rapid wideband frequency hopping, multisymbol alphabets, and/or efficient demodulation matched to sequential decoding has been clearly demonstrated. Author

N68-13213# Lincoln Lab., Mass. Inst. of Tech., Lexington.
COMPUTER SYSTEM
F. E. Heart and W. R. Crowther *In its* The Lincoln Exptl. Terminal 21 Mar. 1967 p 57–75 refs (See N68-13209 04-07)

A digital computer functions as a major subsystem of a satellite communications terminal called the Lincoln Experimental Terminal. The considerations which dictated its role in the communications terminal are examined, and the implementation of that role in terms of a computer program is discussed. Interesting features of the system include: antenna pointing and transmitter–receiver tuning; message traffic control with digital speech going through the computer memory in real time; unusually flexible computer-driven console controls; and asynchronous interrupt-based program design. The computer system has operated successfully as part of the terminal for over a year. Author

N68-13214# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A SEQUENTIAL DECODING TECHNIQUE AND ITS REALIZATION IN THE LET
I. L. Lebow and P. G. McHugh *In its* The Lincoln Exptl. Terminal 21 Mar. 1967 p 77–101 refs (See N68-13209 04-07)

The Lincoln Experimental Terminal (LET) uses convolutional encoding and sequential decoding matched to a modulation system employing a 16-ary orthogonal alphabet and matched-filter envelope detectors, followed by an ordered list of the filters containing the 7 largest outputs. This coding system employing a constraint length of 60 bits and rates of 1 and 2 bits per orthogonal symbol achieves operation at an energy-to-noise ratio of 6 dB per information bit on an active satellite (Gaussian) channel. The Fano decoding algorithm is employed. After a brief description of this algorithm, the realization of the LET encoder–decoder is presented. The machine using a commercial magnetic core memory, together with about 2000 integrated circuit elements, occupies about 20 inches of 19-inch rack space. Author

N68-13215# Lincoln Lab., Mass. Inst. of Tech., Lexington.
CHANNEL VOCODER
Joseph Tierney and J. N. Harris *In its* The Lincoln Exptl. Terminal 21 Mar. 1967 p 103–112 refs (See N68-13209 04-07)

A channel vocoder has been designed as the speech processor for a satellite communication terminal (the Lincoln Experimental Terminal). The vocoder functions at two separate data rates: a pitch-excited mode (PEV) at 4800 bits/s and a high-rate 9600-bit/s voice-excited (VEV) mode. The low rate takes advantage of a high-quality, dynamic microphone input at or near the vocoder while the VEV permits inputs from remote speakers using the ordinary switched telephone plant. Each mode has several features worthy of note. The PEV uses a digital pitch extractor along with a combination analog and digital buzz–hiss detector. This mode transmits about 1200 bits/s for excitation and 3600 bits/s for 18 channels. In the VEV mode, bandpass sampling of the 200- to 900-Hz baseband signal results in an excitation rate of about 7200 bits/s. The spectral channel rate is 2400 bits/s for 10 channels. Both modes employ 4-bit coding relative to the instantaneous maximum spectral signal to reduce the size of the quantization steps. Author

N68-13222# Syracuse Univ. Research Inst., N. Y. Electrical Engineering Dept.
COMPUTER DESIGN OF UNEQUALLY SPACED ARRAYS
Harvey K. Schuman and Bradley J. Strait 1 Oct. 1967 72 p refs
(Contract AF 19(628)-5882)
(EE-0967-4; AFCRL-67-0552; SR-4; AD-661593)

Analytical techniques presented thus far for treatment of unequally spaced antenna arrays have pointed out that desirable radiation characteristics can be achieved using only the interelement spacings as design parameters. The advantage is that the excitation amplitudes required can be either uniform or nearly uniform across the array, thereby allowing use of a simple feed system for excitation of the array elements and minimizing adverse mutual coupling effects. The design methods have found only limited applications, however, since results are not always reliable due to the approximations necessary to simplify the analytical work. Various computational methods have been presented to circumvent this problem, but these in turn suffer disadvantage in that they provide no control over the ultimate positions of the array elements, giving rise to unrealistic spacing configurations and severe realization problems through mutual coupling. In this work a new computational technique is presented for designing unequally spaced arrays. The method is particularly suitable for use with modern high-speed electronic computers, and allows certain practical restrictions or constraints to be included in the design procedure by allowing use

of a limited number of different excitation amplitude levels. The result in any given example is an unequally spaced linear array designed for a specified sidelobe level, with a number of amplitude levels appropriate for insuring that prespecified spacing restrictions are met. Thus, the practical difficulties encountered with the results of other computational schemes are largely avoided. Several examples are given, and both theoretical and experimental results are included. Author (TAB)

N68-13252 Pan American World Airways, Inc., Patrick AFB, Fla.

MULTIPLE-LINK RECEPTION THROUGH WIDEBAND, NONLINEAR COMPONENTS

P. L. Harton and J. W. McRary Mar. 1967 44 p refs Presented at the Canaveral Council of Tech. Soc., 4th Space Congr., Cocoa Beach, Fla., 3–6 Apr.

(AFETR-TR-67-9; AD-661982)

Whenever multiple signals are present in a wideband RF system, any amplitude nonlinearity in the transfer characteristic of the system can generate inband intermodulation interference and degrade performance. The magnitude of the intermodulation interference depends upon both the characteristics of the system nonlinearities and the power level of the received signals. The expected manifestations of this self-generated interference depend upon the structure of the signal that is to be received. In the report, emphasis is directed toward the effect of intermodulation interference on PCM/FM error rates. TAB

N68-13263# RAND Corp., Santa Monica, Calif.

COHERENCE AND NONCOHERENCE IN RADAR SIGNATURE ANALYSIS

P. Swerling Aug. 1967 37 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5434-PR; AD-661542)

Using Bayes and maximum likelihood statistical estimation, optimum estimates are derived for the distribution of signal power among components of a radar signature, in the presence of additive noise and phase errors, with various constraints on the coherent processing time. Results are expected to provide the first theoretical and practical basis for the Bayes optimum detection of targets in clutter and signature analysis of composite targets. The target signals are represented as the sum of a set of possible components, each component having amplitude and phase modulations of known form but unknown absolute amplitude and initial r-f phase, and the quantities are estimated as functionals of the distribution of signal power. The processing may involve varying degrees of coherence and noncoherence, due either to phase deviations or to failure of the radar to preserve phase information. Author (TAB)

N68-13271# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

THE MEASUREMENT OF INTEGRATED REFRACTIVITY FOR EVALUATING ATMOSPHERE-INDUCED RADAR RANGING ERRORS

W. G. Tank Sep. 1967 33 p refs Presented at the Conf. on "Unguided Rocket Ballistics Meteorol.", New Mex. State Univ., Las Cruces, 31 Oct.–1 Nov. 1967

(D1-82-0639; AD-661397)

Line-integrated refractivity is isolated as the basic parameter required for correcting atmosphere-induced radar ranging data errors. A basis for the determination of integrated refractivity from measurements of the absorption or emission of infrared and of microwave radiation by atmospheric oxygen and water vapor, with subsequent interpretation of those measurements in terms of integrated oxygen and water-vapor partial densities, is then established. Both active and passive absorption-measuring systems applicable to the range data-correction problem are described. Finally, examples of integrated oxygen and water-vapor partial densities obtained with active infrared and passive microwave instrumentation of the types described are presented. It is estimated that incorporation of such instrumentation into ranging systems will permit a real-time line-integrated refractivity measurement accuracy of about 1 percent in total line-integrated refractivity. Author (TAB)

N68-13278* Texas Univ., Austin. Antennas and Propagation Div.

SURFACE REFRACTIVE INDEX DIFFERENCES AT 14,250 FEET ELEVATION

A. P. Deam, A. W. Straiton, and J. L. Dodd 30 Nov. 1967 20 p refs

(Grant NGR-44-012-048)

(NASA-CR-91348; P-22) CFSTI: $3.00 CSCL 18N

Surface refractivity at 14,250 feet elevation is reported in the form of difference measurements. Spectra, amplitude distributions, and structure functions are computed and included. Values of C_n^2 may be inferred from the structure functions. The "frozen in" hypothesis is examined by comparing time spectra of the difference measurements with theoretical computations for this spectra. Structure functions at 14,250 feet (surface) are compared with those at 785 feet elevation (280 feet above surface). Author

N68-13305# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.

DIFFRACTION BY ROCKET EXHAUSTS

Kurt E. Golden, Edward C. Taylor, and Francis A. Vicente May 1967 21 p refs

(Contract AF 04(695)-1001)

(TR-1001(2220-10)-5; SSD-TR-67-147; AD-661580)

Review of Titan IIIC flight data shows that VHF and C-band signals received in the shadows of the rocket exhaust propagate by diffraction around the plume. Scale-model experiments show that the intensity of such signals depends primarily on the diameter of the plume and the position of the antenna and only slightly on either the plume shape or surface. It is shown that lower bounds for signal strength can be calculated with a straightedge diffraction model. It is concluded that the simple mathematical model constitutes a useful tool for the planning of communications and tracking systems for launch vehicles. Author (TAB)

N68-13309# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NOISE STABILITY AND EFFECTIVENESS OF COMMUNICATIONS SYSTEMS

A. G. Zyuko 13 Mar. 1967 408 p refs Transl. into ENGLISH of the book "Pomekhoustoychivost' i Effektivnost Sistem Svyazi" Moscow, Gos. Izd. Lit. Po Vopr. Svyazi i Radio, 1963 p 1–320

(FTD-HT-66-355; AD-661892)

The book is devoted to problems of communication system noise stability and efficiency. Along with the classical theory of noise stability when there is fluctuating noise, this book considers problems of noise stability for channels with randomly changing parameters and some problems of noise stability for noise effect from adjacent stations, pulse noise, etc. The reference value for communication systems is derived on the basis of two properties: noise stability and efficiency. The perfect communication system is defined as a system assuring the greatest efficiency for a given noise stability or vice versa. All of these problems are not given thorough coverage; some are summarized without proofs and others are given only literature references. Optimal methods of reception for different types of transmission and methods for attaining potential noise stability are analyzed. Problems involving the practical

realization of different communication system circuits are not considered. Author (TAB)

N68-13350* Houston Univ., Tex. Electrical Engineering Dept.
GENERAL MULTIPLEXING THEORY Semiannual Progress Report, 1 Jun.–30 Nov. 1967
R. D. Shelton and J. D. Bargainer 1 Dec. 1967 29 p refs
(Grant NGR-44-005-039)
(NASA-CR-91386) CFSTI: $3.00 CSCL 09F

Summary information is presented on the research being conducted on coding theory, communication theory, and advanced television techniques in order to provide a well-defined mathematical model and system design for a coded communication system. The feasibility of combining the ranging and digital telemetry bit streams of an Apollo-type communications system into one composite bit stream is examined. A method is described for combining the signals before modulation to form one binary signal to be transmitted. It is pointed out that this type signal lends itself readily to psk modulation and thus promises an increase in signal to noise ratio, and a decrease in crosstalk over the method of modulating subcarriers with the data signals and combining these with the transmitted range code. M.G.J.

N68-13375* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DUAL DETECTION SYSTEM IMPROVES AIMP PFM DATA PROCESSING
Thomas J. Karras Nov. 1967 30 p refs
(NASA-TM-X-63062; X-563-67-550) CFSTI: $3.00 CSCL 09F

A dual detection system used for processing PFM telemetry data has proven to be superior over a single threshold detection system. This dual detection system employs two methods: (1) Threshold detection of 128 individual filters during the transient buildup time when the filters are excited with a PFM burst, and (2) Greatest-of-detection of the 128 filters to determine the largest amplitude near the end of the filter buildup, called "Auction Detection." The threshold method is only employed for system synchronization while the auction method is used for data recovery. Up to 10% more data recovery on actual AIMP satellite tapes are being achieved; up to one half order of magnitude improvement in rms error in the experimenters analog data is expected. The incoming signal-to-noise threshold of the system has not been lowered, because line synchronization has remained unchanged. This dual detection system is presently used to process the AIMP D and E telemetry data at the GSFC data processing facilities. Author

N68-13437* Kansas Univ., Lawrence. Engineering Science Div.
SOME EMPIRICAL AND THEORETICAL INTERPRETATIONS OF MULTIPLE POLARIZATION RADAR DATA
R. D. Ellermeier, A. K. Fung, and D. S. Simonett 1966 17 p refs Presented at the 4th Symp. on Remote Sensing of the Environ., Mich. Univ., Ann Arbor, 11–14 Apr. 1966
(Contract NSR-17-004-003; Grants NsG-298; NSF GP-2259)
(NASA-CR-91472; CRES-61-10) CFSTI: $3.00 CSCL 17I

Experiments using aircraft-borne polypolarization radars have shown that terrain phenomena are identifiable and that inferences, at least, may be drawn as to the compositional nature of these phenomena. Recent theoretical has shown that to a first order approximation: 1) the direct polarized backscattered radar signal is proportional to the product of the appropriate Fresnel reflection coefficient and the sum of the cosine of the angle of incidence and a slope term measured along the terrain profile in the plane of incidence; 2) The cross polarized backscattered radar signal is proportional to the product of the sum of the two Fresnel reflection coefficients and the slope measured along the profile perpendicular to the incident plane. Thus, a measure of the surface roughness may be obtained by proper instrumentation of the direct and cross polarized components of the signal return. This development is unique in that the cross polarized as well as the direct polarized return components are explicit in the formulation. Empirical evidence supporting the theoretical study has been obtained from analysis of multiple polarization imagery using single frequency direct and cross polarized radar data. Author

N68-13448# Navy Electronics Lab., San Diego, Calif.
COMPOSITE DISCAGE ANTENNA DEVELOPED FOR 2- TO 30-MC/S BAND
S. E. Parker, L. G. Robbins, and W. J. E. Edwards 8 Aug. 1967 49 p refs
(NELC-1504; AD-661464)

The vertically polarized antenna has VSWR of 3 to 1 or better throughout band, and provides omnidirectional coverage in horizontal plane. Low-angle radiation is provided by the cage section at most frequencies from 2 to 8 Mc/s. Vertical patterns -- with a major lobe at relatively low angles -- are provided by the discone section from 8 to 30 Mc/s and higher. Auxiliary networks insure stability of impedance and pattern characteristics. Author (TAB)

N68-13471# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
STATISTICAL COMMUNICATION THEORY
Y. W. Lee, A. G. Bose, J. D. Bruce, A. V. Oppenheim, D. E. Nelsen et al *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 135–146 refs (See N68-13461 04-23)
(Grant NSG-496)

The mathematical properties of the cepstrum were analyzed, and the probable use of the cepstrum in a model accounting for pitch perception in psychoacoustics was considered. The cepstrum is defined as the Fourier transform of the logarithm of the amplitude spectrum of a signal. Analytical computations showed that the cepstrum is almost insensitive to a large class of weighting functions and thus can be used for time properties of the signal. G.G.

N68-13472# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PROCESSING AND TRANSMISSION OF INFORMATION
P. Elias, R. M. Gallager, M. M. Goutmann, E. V. Hoversten, D. A. Huffman et al *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 147–151 refs (See N68-13461 04-23)
(Grant NSG-334)

A Plotkin bound for block codes is extended to convolutional codes, with symbols in an arbitrary finite field, by denoting the greatest minimum distance of convolutional codes with rate and memory in subblocks. Thus, convolutional codes are considered linear tree codes. A decoding procedure called semidefinite decoding is described that allows the use of previous decoding decisions without the danger of infinite error propagation by employing a syndrome register in the decoder. A bound or definite decoding distance with convolutional codes is obtained by defining the fewest number of positions in which there is disagreement in the vector for information sequences with different values. G.G.

N68-13498 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Flugfuehrung.
MEASUREMENT OF TRAJECTORIES OF SMALL ROCKETS WITH DFL RADAR TRACKING EQUIPMENT [DIE VERMESSUNG DER BEHNEN KLEINER RAKETEN MIT DEM RADARGERAET DER DFL]
K. Hurrass 27 Apr. 1967 32 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-67-09)

Measurements of flight trajectories of small rockets when using the 3 cm tracking radar are reported. The ranges of the rockets extended up to 15 km, and the microwave radar cross section of these rockets was estimated to be from 0.02 to 0.1 square meters. A point to the side of the trajectory of a rocket was found to be the optimum site for the radar tracking equipment. In analyzing the measured data, second order polynomial curve fitting proved to be useful and gave satisfactory results. Author

N68-13560*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GENERIC CONCEPTS OF THE AUTOMATED MULTI-FUNCTIONAL RECEIVER
John W. Bryan Apr. 1967 16 p refs
(NASA-TM-X-63057; X-523-67-233) CFSTI: HC $3.00/MF $0.65 CSCL 17B

The construction, operation, and maintenance criteria are explained without design details. The operational requirements of a single receiving system that will fulfill the needs of the Space Tracking and Data Acquisition Network (STADAN), the Manned Space Flight Network (MSFN), and the Deep Space Network (DSN) are enumerated. The RF circuitry of this receiver is very similar to that used in telemetry and ranging receivers. An explanation of computer-driven switches to set up the receiver and the use of test and monitor points to calibrate and diagnose receiver troubles are presented. A flow diagram and a suggested manual control keyboard are included. Author

N68-13600# White Sands Missile Range, N. Mex. Processing Sciences Div.
DISCRETE RECURSIVE ESTIMATION: AN OPTIMUM AUTOMATED DATA PROCESSING TECHNIQUE FOR MULTI-ELECTRONIC TRACKING SYSTEMS
Maceo T. Scott *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 491–532 ref (See N68-13581 04-31)

Automation of range instrumentation data handling and the improvement of information recovery quality from simultaneous tracking instruments are problems always in need of updating. An approach to solving some of these problems through judicious selection of mathematical techniques are herein presented. This study seeks to show how optimal estimation and recursive procedures are being utilized at several stages in a single pass computer program to accomplish the following: (1) correct for instrumentation system and geodesy errors through optimal transformations; (2) provide an inherent data editing procedure; (3) provide best estimates of the trajectory and the dynamic variables; and (4) provide covariance matrices of the tracking instrument observation errors and recovery of the errors for each of the instruments. The results appear as a set of optimum trajectory parameters which are delivered in final report form. The time consumed to handle the total processing of N-radar stations is approximately 1-1/2 minutes of direct coupled system (DCS) machine time per minute of flight time and hence make these techniques highly attractive for operations that involve the processing of large quantities of electronic tracking data on a timely basis. Author

N68-13777* General Precision, Inc., Little Falls, N. J. Kearfott Products Div.
DEVELOPMENT PROGRAM FOR RESOLVER/DIGITAL CONVERTER, C704772010 Final Report
J. V. McSenna 28 Feb. 1967 25 p
(Contract NAS8-20608)
(NASA-CR-91503) CFSTI: $3.00 CSCL 09F

A design approach to a development program for a resolver/digital converter is outlined. The technique requires phase demodulation of the resolver output signals relative to the resolver excitation voltage and the imposition of the resulting DC voltages as initial output voltage states of two precision electronic integrators. These integrators are then connected by electronic switching in an oscillatory loop consisting of the two integrators and a precision inverter. In the course of the resulting oscillation the integrator output waveforms are sinusoidal and in quadrature with one another. Each integrator output is continuously introduced to a zero crossing detector. The time interval between the start of oscillation and the first integrator crossover to occur is a direct function of the resolver shaft angle. This time is measured by accumulation in a counter of pulses from a precision clock generator during the interval. The accuracy of the demodulator is discussed, and a summary of test results is given. L.S.

N68-13826*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY PERFORMANCE ANALYSIS OF HIGH-SPEED DIGITAL DATA CIRCUITS IN THE NASCOM NETWORK
William B. Dickinson, Daniel C. Stern, and Terence C. Wollaston (Weapons Res. Estab., S. Australia) Aug. 1967 54 p refs Revised
(NASA-TM-X-63058; X-576-67-264) CFSTI: HC $3.00/MF $0.65 CSCL 17B

A performance evaluation of voice-bandwidth channels used in the high speed data transmission of NASCOM (National Aeronautics and Space Administration communications network) is reported. All channels for which performance data is presented are four wire, full period, voice-bandwidth data quality services. Most of the channels discussed are trans-oceanic cable services which may come under the jurisdiction of several common carriers and may extend to 12,500 statute miles in length. Data are also presented on communications-satellite data transmission services. Tests indicated that: (1) Where 4B quality circuits can be provided and maintained on overseas long haul channels, error rates of 1×10^{-5} can be obtained consistently at 2400 bps using the WECO 205B data modem. (2) Arranging 4B circuits in tandem in order to provide extremely long haul facilities (over 10,000 miles) is quite successful as long as data regeneration is accomplished at the points where the circuit segmets meeting 4B design goals interconnect. (3) The prevailing atmosphere of cooperation among carriers has permitted the establishment of long channels, traversing up to three different areas of common carrier control, which meet 4B design goals. (4) Circuits provided in accordance with the 4B design goals typically exhibit quite stable amplitude-response and envelope-delay characteristics. S.C.W.

N68-13879*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CARRIER REPRODUCTION IN A DIVERSITY RECEIVER
John W. Bryan Oct. 1967 9 p refs
(NASA-TM-X-63069; X-523-67-527) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Described is a method which will supply, to the doppler extractor, a signal bearing frequency and phase characteristics which are similar to that of the received signal. Under the assumption stated this will be the correct frequency and phase information and resolves problems associated with reconstruction of the received frequency. Using this method the doppler extractor will receive a frequency which has no abrupt switching transients yet is phase related to the strongest received signal. Full coherence is not claimed because the output of VCO #3 (voltage controlled oscillator) will be some average frequency and phase and not necessarily the exact frequency and phase of either secondary VCO. This method can be used in polarization diversity systems, or in space diversity systems where receiving antennas are placed some distance apart in an effort to overcome signal fading. This method may also be applied to frequency diversity systems in a backup ranging system. S.C.W.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-12871* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A COMPUTER PROGRAM FOR MACHINE DESIGN OF CASSEGRAIN FEED SYSTEMS
P. D. Potter 15 Dec. 1967 37 p refs
(Contract NAS7-100)
(NASA-CR-91406; JPL-TR-32-1202) CFSTI: $3.00 CSCL 09B

A computer program has been written for the design of Cassegrain antenna systems that incorporates engineering knowledge obtained in the design of the Deep Space Instrumentation Facility (DSIF) Advanced Antenna System (AAS) feed systems. Consisting of a main monitor program, together with several subroutines which perform specific engineering functions, the program is organized to permit periodic upgrading as more engineering information and requirements become available. The program is obtainable both in Fortran IV for use on the IBM 7094, and in Fortran II for use on the IBM 1620. Author

N68-12917* Kinelogic Corp., Pasadena, Calif.
HELICAP PACK TAPE TRANSPORT Final Report
J. T. Blakistone and P. R. Rahm Oct. 1967 46 p Prepared for JPL
(Contracts NAS7-100; JPL-951348)
(NASA-CR-91447) CFSTI: $3.00 CSCL 14D

The design problems encountered in developing a multilayered, helically-oriented, edge-wound band of magnetically coated tape and a mechanical transport to handle the helical pack are described. Tape transporting methods are compared, and concepts for the helical pack loop transport configuration and for forming the helical tape pack from an ordinary reel of magnetic tape are assessed. Extensive design analyses led to modifications in the original model specifications. Two patentable concepts were developed: the pressure belt device used to form the straight Mylar type into helical form, and the double reel configuration for the tape transport. It was concluded that the major problems of developing such a device were delineated, and that the efficacy of using the helical concept for bulk data storage was partially demonstrated. M.G.J.

N68-12940# RAND Corp., Santa Monica, Calif.
INSTRUCTIONS FOR USING EXPERIMENTAL 0-1 INTEGER LINEAR PROGRAMMING CODE RIP23J
A. M. Geoffrion and A. B. Nelson Nov. 1967 30 p refs
(P-3711; AD-662007)

The program solves integer linear programs of the form (P) Minimize cx subject to b + Ax = or > 0, x sub j = 0 or 1 where c and x are n-vectors, b is an m-vector, and A is m by n. Any bounded integer linear program can be written in this form, using elementary manipulations if necessary. Familiarity with 2 previous papers in the series is assumed. TAB

N68-12950# RAND Corp., Santa Monica, Calif.
IGS—THE INTEGRATED GRAPHICS SYSTEM FOR THE S-C 4060
Gary D. Brown Nov. 1967 12 p refs Presented at UAIDE, Washington, D. C., 16 Oct. 1967
(P-3722; AD-662008)

IGS, the Integrated Graphics System, is a machine independent group of subroutines which may be called to produce graphic output on the S-C 4060. The subroutines may be called from FORTRAN, COBOL, machine language, or PL/I. Author (TAB)

N68-13008# System Development Corp., Santa Monica, Calif.
TRACE—MODEL 2 USER'S GUIDE. TIMESHARED ROUTINES FOR ANALYSIS, CLASSIFICATION AND EVALUATION
Richard P. Esada 9 Oct. 1967 208 p
(Contract DAHC15-67-C-0277)
(TM-2621/003/00; AD-661604)

The document presents a users description of the TRACE system, which provides an on-line technique for scanning data and deriving variables. It is divided into two main sections: the first a tutorial guide introducing the user to the basic principles of the system, and the second a reference guide to the entire body of the TRACE program. The user is shown how to initiate an interaction with the time-sharing system, how to employ every capability of TRACE, what errors may be expected in operation, and what statistical products may be derived through use of the program. A complete index allows the user to refer readily to any portion of the document. Author (TAB)

N68-13078# Mitre Corp., Bedford, Mass.
A METHOD FOR THE EVALUATION OF SOFTWARE: EXECUTIVE, OPERATING OR MONITOR SYSTEMS
Arthur E. Budd Sep. 1967 104 p
(Contract AF 19(628)-5165)
(MTR-197, V. 3; ESD-TR-66-113, V. 3; AD-661999)

The report contains features of executive, operating or monitor systems considered important for evaluation and comparative analysis. These features are identified in a form expressly for inclusion in the Three Step Method for Software Evaluation (Volume 1 of this series) under Category TWO: Executive, Operating or Monitor Systems. Included in this volume is a composite list of functions contained in current executive systems. These functions provide the basis for a standard approach to the software category of executive systems particularly needed for evaluation and comparative analysis. Author (TAB)

N68-13092# RAND Corp., Santa Monica, Calif.
THE COMPUTER IN YOUR FUTURE
W. H. Ware Nov. 1967 48 p
(P-3626; AD-661551)

The report is divided into 2 main parts. The first part is a tutorial discussion of present developments in the computer field, both for hardware and for software. The second part discusses potential future applications for the computer. TAB

N68-13127# RAND Corp., Santa Monica, Calif.
JOSS: CENTRAL PROCESSING ROUTINES
J. W. Smith Aug. 1967 188 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5270-PR; AD-661539)

This is a reference guide for JOSS users to (1) the language used for couching instructions to JOSS; (2) JOSSs responses to instructions; (3) the collection of machine-language routines (in JOSSs central computer) responsible for interpreting and responding to instructions; and (4) the details and decisions that bilaterally influenced the language and the design and implementation of the routines. The myriad details of total system design are given constant exposure, and particular emphasis is placed on the delicate balance and symbiosis that must exist among system, language, computer, and routines and on the pervasive effects of each component on the others. The material is presented in a narrative form, augmented by flow-chart representations of most of the principal routines, and is in part designed to serve as prolegomena to the annotated machine-language listings of the routines (copies of which are obtainable from RAND). Author (TAB)

N68-13162* TRW Systems, Redondo Park, Calif.
STUDY OF MECHANICAL SHOCK SPECTRA FOR SPACECRAFT APPLICATIONS, APPENDIX 4. SPECTRAL COMPUTER PROGRAM PROGRAMMER'S MANUAL Final Report, 29 Apr. 1966–1 May 1967
T. T. Wang 1 May 1967 213 p
(Contract NAS5-10166)
(NASA-CR-91380) CFSTI: $3.00 CSCL 09B

Response or Fourier spectrum for a base-excited, viscous damped, single degree-of-freedom oscillator is produced by a spectral computer program that is described in this programmer's manual. The BCD input data can be on cards, as binary data on tape, or as an analytic function programmed by the user. The required quantity is computed using an algorithm based on digital filtering; and the program computes and prints the spectrum for the Fourier variable, relative displacement, relative velocity, and absolute acceleration. The program can also plot the computed spectrum. The problem of mechanical shock spectra related to spacecraft applications is described, along with the input and output. Operating instructions are detailed, and a sample case and a program listing are included. M.W.R.

N68-13204# System Development Corp., Santa Monica, Calif.
AN ANALYTICAL COST COMPARISON OF COMPUTER OPERATING SYSTEMS
Warren J. Erikson 30 Jun. 1967 203 p refs
(Contract F19628-67-C-0004)
(SDC-TM-3525; AD-661983)

The report attempts to answer some of the questions concerning the advantages and disadvantages of time-sharing. To accomplish this, the general problem of evaluating computer system performance is first addressed. General system characteristics are specified that include the computer and its operating system, and users and their jobs. The main emphasis is placed upon the operating system; the effects of having different computers, users, or jobs are treated as parameters. The most important evaluation criterion is considered to be cost, which includes both user cost and computer system cost. Quantitative models are developed that describe computer center users, the programs they run, and the different operating systems they might use. TAB

N68-13218# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CHARS AUTOMATIC CORRELATION READER WITH SHIFT REGISTER [KORRELYATSIONNYY CHITAYUSHCHIY AVTOMAT SO SDVIGOVYM REGISTROM CHARS]
A. S. Barashko, V. A. Kovalevskiy et al 27 Apr. 1967 35 p refs Transl. into ENGLISH from the Publ. "Chitayushchiye Avtomaty i Raspoznavaniye Obrazov" Kiev, Naukova Dumka, 1965 p 184–207
(FTD-HT-67-157; AD-661424)

The authors developed a reading automaton with a shifting register (ChARS) which they subsequently tested in several tube or transistorized versions. The device can process no less than 200 bits/sec, and error probability is no more than 0.01%. The device requires some 2500 parts. The article describes the appropriate algorithm, principles for the engineering realization of this algorithm, the photoelectric component and the mechanism for pattern advance, the shifting register, the standard-containing block, the extremum indication block, and the control unit. General tests were carried out in conjunction with the Kiev computer. The experimental model is now being used for the accumulation of statistical data needed for the determination of recognition reliability. The results are printed on the AEPU-45 electric typewriter. TAB

N68-13260 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMPUTER TECHNOLOGY Surveys of Foreign Scientific and Technical Literature
22 Dec. 1967 54 p refs *Its* ATD Work Assignment No. 87
(ATD-68-17-87-1; Rept.-11)

Various compounds for hermetic sealing of ferrite-core elements were tested. The aim of these tests was to find compounds which, when solidified around core elements, do not bring about stresses that influence the electrical parameters of the cores. The authors tested six compounds, noting their temperature of vitrification (temperature at which the polymer loses its high elasticity) and other parameters. Author

N68-13265# Michigan Univ., Ann Arbor. Systems Engineering Lab.
COMPUTER PROGRAMS DEALING WITH FINITE-STATE MACHINES PART 1
Thomas F. Piatkowski May 1967 41 p refs
(Contract AF 30(602)-3546)
(SEL-TR-11; Rept.-06920-9-T; AD-657999)

A number of algorithms were programmed dealing with finite-state machines; the purposes of this effort being: (1) pedagogical application, (2) the stimulation of insight, and (3) the generation of new questions and approaches. Out of a set of thirty-eight more or less different problems dealing with finite state machines, seven representatives were selected; namely: (1) simulate a given machine, (2) determine if a given machine is strongly connected, (3) determine the state equivalence classes and minimal form for a given machine, (4) determine the automorphisms and their group for a given machine, (5) determine a shortest simple adaptive diagnosing experiment for a given machine and admissible set, (6) determine an equivalent regular expression for a given machine, (7) exhibit the lattice of SP partitions for a given machine. This report, the first of two, describes the programs treating problems one through four, a second report treating problems five through seven is contained in AD-658 001. TAB

N68-13268# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE ORDER CODE FOR COMPUTER CONTROL [SISTEMA KOMAND DLYA UPRAVLYAYUSHCHEY VYCHISLITEL'NOY MASHINY]
E. A. Trakhteneyerts and V. Ye. Yurchenko 9 Jun. 1967 27 p refs Transl. into ENGLISH from Avtomat. Poeativnoye Upr. Proizv. Protsessami (Moscow), 1965 p 101–112
(FTD-MT-67-1; AD-661763)

In formalizing the control and continuous industrial regulation algorithms by means of the table-address method and by generalized programming languages various researchers established the fact that the given algorithm consists of a series of periodically repeating standard operators. It became obvious that these operators should be realized within the system of commands of control computers. The present authors, consequently, present an appropriate system of commands and explain the writing down of such a system. They divide the control and the regulation algorithm into separate operations in such a way that the algorithm is divided into a minimum number of operators with a maximal repetition rate. TAB

N68-13289# Radio Corp. of America, Princeton, N. J.
AN INTRODUCTION TO CDL1, A COMPUTER DESCRIPTION LANGUAGE
Chitoor V. Srinivasan Sep. 1967 124 p refs
(Contract AF 19(628)-4789)
(SR-1; AFCRL-67-0565; AD-661591)

The objective of this report is to develop a formal language to describe hardware and software computing systems. The language is to provide a linguistic basis to consider machine-aided solutions of a variety of design problems; i.e., problems concerning design documentation, data retrieval systems, system simulation, diagnosis, analysis and synthesis. This report discusses in some detail the considerations that went into the design of the computer description language, called CDL1; it points out the need for developing such a language and briefly discusses the kinds of applications such a language may have. The report points out the various kinds of system descriptions one may encounter in a design process and relates them to the language features necessary to express them; the language itself is described informally. Examples are presented to illustrate the use of the language, the concepts associated with descriptions of systems at various stages of design, and the consequent hierarchical structure such descriptions acquire. Author (TAB)

N68-13294# System Development Corp., Santa Monica, Calif.
SPECIFICATION OF SPL SPACE I PROGRAMMING LANGUAGE
Levi J. Carey, Al E. Kroger, and Christopher J. Shaw 30 Sep. 1967 158 p
(Contract F04695-67-C-0096)
(SDC-TM-3719/000/00; SAMSO-TR-67-23; AD-661981)

The document contains a complete specification of the Space Programming Language (SPL) in Backus-Naur form. A description of basic SPL and extensions is given. SPL is a space application language with a large array of capabilities. It is further an extendable language with punctuation rules and vocabulary designed for ease of learning and programming. Author (TAB)

N68-13354*# National Aeronautics and Space Administration, Washington, D. C.
COMMAND BY SPEECH IN AEROSPACE AUTOMATION
F. Winckel Dec. 1967 9 p refs Transl. into ENGLISH from German Presented at the Ann. Meeting held in Berlin, 14–18 Sep. 1964
(NASA-TT-F-11391) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A discussion of automatic control based on the recognition of phonetic patterns by control equipment is given. The effects of delayed speech feedback are reviewed, and the acoustic properties of speech are described. A formant-coding speech-compression system is examined in which additional linguistic control is achieved by using the statistical dependence of subsequent tones in the sense of a Markov chain. It is shown that the state of the art enables the realization of a command language consisting of about 10 words—the numbers from 0 to 9, for example. Author

N68-13386 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugmechanik.
REPORT ON THE COMPUTATION CENTER OF THE DEUTSCHE FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT FOR THE YEAR 1966 [BERICHT UEBER DAS RECHENZENTRUM DER DEUTSCHEN FORSCHUNGSANSTALT FUER LUFT- UND RAUMFAHRT FUER DAS JAHR 1966]
R. Ludwig Apr. 1967 64 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-67-04)

This report covers methods, programs, capabilities, equipment, and work operations of the computer center during 1966. Summaries are presented of all 150 problems that were worked on the center's Siemens 2002 digital computer and the Pace 231 R analog computer. K.W.

N68-13387# Tracor, Inc., Austin, Tex.
DATA MANAGEMENT: A COMPARISON OF SYSTEM FEATURES
Theodore W. Ziehe Oct. 1967 43 p refs
(Contract N00014-67-C-0396)
(TRACOR-67-904-U; AD-661861)

Features of four data management systems under development are compared. The four systems are the Time-Shared Data Management System (System Development Corporation) and a variant of it, the Remote File Management System (Computation Center, The University of Texas); Data Manager - 1 (Auerbach Corporation); the Generalized Information System (IBM); and the Catalog System (The RAND Corporation). Comparisons are drawn in two areas: external and internal data structuring and organization. Several differences among the systems are noted and briefly discussed. Author (TAB)

N68-13392# Iowa Inst. of Hydraulic Research, Iowa City.
OLD GOLD MODEL, TYPE 4-2H HOT-WIRE ANEMOMETER AND TYPE 2 MEAN-PRODUCT COMPUTER
John R. Glover Jul. 1967 38 p refs
(Contract Nonr-1509(03))
(IIHR-105; AD-661850)

Detailed descriptions of the operating procedure, functional characteristics, and circuit operations are presented to provide the user with the background necessary for obtaining hot-wire measurements. Author (TAB)

N68-13399# System Development Corp., Santa Monica, Calif.
THE ENVIRONMENT OF COMPUTER OPERATING SYSTEM SCHEDULING: TOWARD AN UNDERSTANDING
Einar A. Stefferud 7 Nov. 1967 15 p
(SP-2995; AD-661666)

Scheduling and allocation of computing facilities is generally carried out in a very primitive and ineffective way. The difficulty stems from a number of sources including: (1) semantic confusion, (2) failure to consider all relevant factors, (3) failure to establish a global context for analysis of specific operational problems. This paper attempts to establish the required context by considering all relevant factors and by carefully sorting out the semantics. Specifically, market principles are employed to characterize the environment at its most general level. At the detailed level, a model based on the dimensions of (1) demand magnitude, (2) interaction rate, and (3) deadline penalty severity is presented. Author (TAB)

N68-13425*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
NASCOM ON-LINE DATA-SWITCHING SYSTEM
W. Hahn and Z. Handel Aug. 1968 20 p ref
(NASA-TM-X-63056; X-500-66-403) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The approach used in the design of an automatic data switching system and the results of the design effort are reviewed. The present teletype message switching system and the expanded requirements placed on the network for support of the future missions are described. High-speed data switching is discussed from an integrated hardware–software standpoint in general, with emphasis on software structuring, reliability, and error control. K.W.

N68-13430* Information Dynamics Corp., Reading, Mass.
NASA MICROELECTRONICS DATA BANK PILOT PROGRAM. VOLUME 2: PROGRAM DESCRIPTION

Oct. 1967 216 p refs
(Contract NAS12-147)
(NASA-CR-86019; R-8090-3, V. 2) CFSTI: $3.00 CSCL 09B

Conceptual design and output products are detailed for the pilot program on the NASA Microelectronics Data Bank; and the six tasks involved in the pilot program study are reviewed. These include project management and control, systems and programming, information analysis, machine processing, reprographics, and orientation and assessment. Data identification, evaluation, and extraction as well as microfilming are considered in relation to input data processing. Elements of data requested from vendors and NASA Centers which formed the data base are reviewed, and a copy of the microelectronics directory and indexes on monolithic microcircuits produced during the pilot program is included. M.W.R.

N68-13473# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COGNITIVE INFORMATION PROCESSING
W. L. Black, M. Eden, T. S. Huang, F. F. Lee, S. J. Mason et al *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 153–167 refs (See N68-13461 04-23)
(Grants NIH-1-P01-GM-1490-01; NIH-1-P01-GM-15006-01)

A character-recognition type reading machine for the blind was constructed and evaluated. The system consists of a two-dimensional document handler, a flying spot opaque scanner, and a character-recognition algorithm implemented by a combination computer program–digital system with a spelling speed of 120 wpm. Experiments for effective control of its operation by a blind person showed best results for an operating mode in which the character height was limited, a beep was sounded when a new line started, and the word "next" was spoken when the last letter on a line had been spelled. Also reported is the graphical formulation and sampling rate determination for output signals of a linear time-variant filter which is due to an input signal, and a surface reconstruction from contour samples by treating the contours as boundary conditions on which the value of the surface is known. Included is the block diagram of a computer controlled tactile display system that can simultaneously present up to 8 Braille-like cells to a person's 8 fingers. G.G.

N68-13476# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
COMPUTATION RESEARCH
Eleanor C. River, Elaine S. Brown, Joan Harwitt, Elaine C. Isaacs, Eloise Kleban, et al *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 231–235 (See N68-13461 04-23)

Briefly described is a data taking device that use magnetic tape for storing digitized data such as density, record length, and block size, without block modification. Also presented are a set of numerical integration programs in Fortran 4 that utilize Gaussian quadrature formulas to evaluate integrals which cannot be evaluated by trapezoidal or Simpson's rule. A subroutine is also developed and written to compute both $Y^{(0)}(z)$, the Neumann function, and $Y_{\nu}(z)$, for Weber function, of the Bessel function of second kind. G.G.

N68-13497# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC MONITORING OF THE CORRECT RECORDING OF ALGORITHMS IN THE ALGOL-60 LANGUAGE [AVTOMATICHESKIY KONTROL' PRAVIL'NOSTI ZAPISI ALGORIFMOV NA YAZYKE ALGOL-60]
V. A. Vasil'yev and N. N. Lozinskiy 16 Jun. 1967 33 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 6, no. 1, 1966 p 130–143
(FTD-MT-67-78; AD-661773)

A semantic method for checking the accuracy of ALGOL algebraic problems is proposed. The content and organization of the semantic program are discussed as well as various additional problems associated with freeing the information from errors. The proposed method verifies the program with respect to the following points: (1) the rules established for description of the programs should be observed; (2) the quantities appearing in the program should be used in positions corresponding to their nature; (3) the actual parameters of the procedure operator and the formal parameters for description of this procedure should correspond to one another in the sense that the procedure field, modified according to the rules for syntactic and semantic sense, i.e. these three points should be fulfilled in the operator. A general program is described for carrying out this checking method. This verification system is self-contained with respect to the translator and may be used on machines with less complex coding. Some of the general limitations of the system are pointed out. TAB

N68-13643# Melpar, Inc., Falls Church, Va.
DEVELOPMENT OF AN INPUT/OUTPUT TECHNIQUE FOR INTEGRATED CIRCUIT SIMULATION COMPUTERS
Richard N. McNeal Wright-Patterson AFB, Ohio AMRL Jul. 1967 67 p refs
(Contract AF 33(615)-3449)
(AMRL-TR-67-74; AD-660847)

An input/output technique was developed to interface between integrated circuit computers and simulation systems. Four general types of signals are processed by this input/output system: discrete inputs, discrete outputs, analog inputs, and analog outputs. This study has determined that integrated circuits are readily adaptable to performing the digital functions in the input/output system, but the analog signal conversion requirements of these systems are not within present linear integrated circuit capabilities. It is anticipated that the linear integrated circuit development will have progressed to the point of making integrated circuit converters feasible within the next year. The basic system requirements and the overall system design technique for an input/output system are discussed in detail. Author (TAB)

N68-13678 European Atomic Energy Community, Geel (Belgium).
A CONTRIBUTION TO THE PROGRAMMING OF THE CALCOMP DIGITAL INCREMENTAL PLOTTER FOR OFF-LINE OPERATION
H. Schmid Brussels Oct. 1967 86 p refs
(EUR-3634.E)

The following computer programs for the off-line use of a Calcomp digital incremental plotter are described: 1) an IBM 7090 subroutine PLOT in FAP which is compatible with the plotter subroutine package of P. Moinil and J. Pire of CETIS, 2) an IBM 1401 program in SPS which translates magnetic tape plotter data from CETIS code into original Calcomp code, and 3) a set of plotter subroutines for the IBM 1401 computer in SPS. An example for the application of the IBM 1401 plotter subroutines is given. Author

N68-13742# System Development Corp., Santa Monica, Calif.
CONTROL SETS ON GRAMMARS
Seymour Ginsburg and Edwin H. Spanier 7 Aug. 1967 40 p refs
(Contract F19628-67-C-0008; Grant AF-AFOSR-1203-67)
(SDC-TM-738/036/00; AFCRL-67-0537; SR-9; AD-661970)

Given a set C of strings of rewriting rules of a phrase structure grammar G, we consider the set LC(G) of those words

generated by leftmost derivations in G whose corresponding string of rewriting rules is an element of C. The paper concerns the nature of the set LC(G) when C and G are assumed to have special form. For example, for G an arbitrary phase structure grammar, LC(G) is an abstract family of languages if C is an abstract family of languages, and LC(G) is bounded if C is bounded. Author (TAB)

N68-13803 Joint Publications Research Service, Washington, D. C.
OPTIMAL SELF-TEACHING SYSTEMS
V. S. Pugachev 14 Dec. 1967 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 175, no. 5, 1967 p 1022–1025
(JPRS-43722) CFSTI: $3.00

The theory of optimal learning processes for automatic systems is extended to self-teaching systems when the parameters that describe the input and output signals are unknown and also change in a random manner during the training and operational phases. The necessary equations for determining the required output signals are evolved. M.W.R.

N68-13833 General Electric Co., Bethesda, Md. Information Systems Operation.
TIME-SHARING/ON-LINE SYSTEMS AND OPERATIONS RESEARCH
Hugh V. O'Neill 27 Jul. 1966 48 p refs
(Doc.-66SD295)

Discussed are information utility time sharing on-line systems concepts and their interaction with, and potential for, operations analysis, system analysis, cost-effectiveness analysis, management science, cost-benefits analysis, and cost-utility analysis. Operations research users utilize the computing or data handling system to assist in defining, solving, and editing the attack on a particular problem. Cost effectiveness and evaluation of time-sharing/on-line systems, both with respect to the individual user and to procurement of such a system, are outlined. G.G.

N68-13878*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A RELIABLE SYSTEM FOR SWITCHING CIRCUITS BETWEEN ON-LINE AND OFF-LINE SWITCHING COMPUTERS
Kenneth D. Beach Jun. 1967 16 p
(NASA-TM-X-63059; X-576-67-306) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Described are design concepts of a primary switching center which permits optimum circuit-sharing and flexibility, and thus makes total NASCOM communications resources available if isolated circuit malfunctions occur. The systems design was approached from the view that, at any given time at each of the switching centers, either the A complex of the B complex will be on-line and its alternate will be off-line. The switching center consists primarily of a teletype transfer switch and a data transfer switch. The teletype-transfer system has been installed and operating for nearly two years with a total down time of 8 hours; the only major failure of the system (5 minutes) was identified as a broken wire in the control system. The high speed data transfer switch is being intalled and is expected to have the same reliability as the teletype system on a per circuit basis. S.C.W.

N68-13897*# Philco Corp., Houston, Tex.
COMPUTER ASSISTED INSTRUCTION. FEASIBILITY STUDY
Richard L. Balogh and Don L. Purdum Washington NASA Jan. 1968 445 p refs
(Contract NAS9-1261)
(NASA-CR-917; PHO-TR-307) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Results of a study to assess the potential of using advanced concepts for training flight controllers are presented. Existing computer systems are reviewed and analyzed, and their applicability to flight controller training is deterimed. The functional requirements for an optimum computer assisted system are developed. Costs incurred by programmed instruction are evaluated, and a study is made to determine if this is a cost-effective method of training NASA flight controllers. C.T.C.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-12916* South Dakota State Univ., Brookings.
ADAPTABILITY OF FET MODELS TO COMPUTER-AIDED CIRCUIT DESIGN Final Report
F. C. Fitchen, H. D. Gorakhpurwalla, U. Birznieks, W. W. Goddard, and M. H. Golnitz 15 Oct. 1967 111 p ref
(Grant NGR-42-003-003)
(NASA-CR-91283) CFSTI: $3.00 CSCL 09A

A complete electrical equivalent circuit or model, modified models, and approximate models for metal oxide semiconductor–field effect transistor (MOSFET) devices are described. The models are small-signal lumped representations of the device operated in the active region of the drain characteristics and connected in the common source configuration. Typical parameter values are given for the equivalent circuit elements, and data are presented on the variation in MOSFET parameters with operating point coordinates. Sensitivity studies were conducted to determine the significance of 10 parameters of a typical MOSFET model with regard to voltage amplification, bandwidth, and input and output impedance of a complete single stage. Various load and signal source conditions were assumed, individual elements eliminated from the model, and the resulting performance tabulated. Piecewise linear large signal representation, large signal distortion, and transient representation are considered. Based upon an arcsine description for the transfer characteristic, an expression is derived to define the limiting region for small signal models. M.G.J.

N68-12962# Navy Electronics Lab., San Diego, Calif.
TEMPERATURE-STABILIZED MONOSTABLE MULTIVIBRATOR Research and Development Report, Sep. 1966–May 1967
Francis E. Morris 8 Aug. 1967 52 p refs
(NELC-1506; AD-661481)

The classical voltage-variable monostable multivibrator circuit was analyzed in detail and the equations required to compute its temperature dependence were developed. Guidelines were derived for component selection to optimize the circuit against temperature changes. Two unique modifications, to compensate for the base-emitter junction voltage changes, were found to improve pulse-width stability with temperature variations. Three circuit designs were developed and tested over a broad temperature range; experimental and calculated data for each were compared and found to agree well. Author (TAB)

N68-12972*# Fairchild Semiconductor Corp., Mountain View, Calif.
MONOLITHIC CIRCUIT TEST STANDARDS
George O. Compton and Joseph R. Adame Oct. 1967 285 p
(Contract NAS8-21199)
(NASA-CR-91346) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Based on a survey of research, development, and manufacturing facilities, test specifications are presented for use in line certification of monolithic circuits. Outline sheets, which identify the purpose, the apparatus and materials required, the procedures, calibration techniques, the obtainable accuracy, and the recommended test frequency,are presented on 64 test methods. Observations are offered on the inadequacy of radiographic techniques when examining devices manufactured with loss mass materials, and the need for improved procedures in detecting gross leaks. M.G.J.

N68-12998*# Watkins-Johnson Co., Palo Alto, Calif.
DEVELOPMENT OF A 100 WATT S-BAND TRAVELING WAVE TUBE Quarterly Progress Report
L. A. Roberts and M. V. Purnell 27 Oct. 1967 20 p Prepared for JPL
(Contracts NAS7-100; JPL-951299)
(NASA-CR-91442; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Continued research focusing on the development of the WJ-395, a 100 watt, 55 percent efficiency, 2.3 GHz traveling wave tube for space applications, is reported. The effects of peak magnetic field strength and magnet period were tested on Tube S/N 6. Tube S/N 7 was built and tested. It was found that its performance was below that expected for the design change incorporated in this tube. From the performance tests it was reasoned that helix loss in the output section had led to the reduced efficiency. Author

N68-13041# Microwave Electronics Corp., Palo Alto, Calif.
INVESTIGATIONS OF BROADBAND FERROMAGNETIC POWER LIMITERS AND EXPANDERS AS DUPLEXING ELEMENTS FOR MICROWAVE SYSTEMS Quarterly Report, Jun. 1–Aug. 31, 1967
Peter Young and F. A. Olson Nov. 1967 34 p
(Contract DA-28-043-AMC-02120(E))
(ECOM-02120-5; QR-5; AD-661641)

Efficient broadband coupling to the lowest order surface magnetostatic mode in a transversely magnetized YIG slab was demonstrated experimentally. The coupling length for a polycrystalline YIG slab was determined. A helix expander was fabricated and tested. Maximum high level loss of not more than 1.5 db was achieved. Subsidiary resonance limiting was observed in a helix structure at C-band frequencies. Threshold is in the 100-mW range. Author (TAB)

N68-13071# Minnesota Univ., Minneapolis. Electron Tube Research Lab.
NOISE MEASUREMENTS AS A TOOL IN ELECTRON DEVICE RESEARCH Technical Report, 1 Feb.–31 Aug. 1967
A. Van Der Ziel Ft. Monmouth, N. J. ECOM Nov. 1967 99 p refs
(Contract DA-28-043-AMC-01880(E))
(Rept.-4; ECOM-01880-4; AD-661640)

Noise measurements in transmission type secondary electron multipliers, image intensifier multipliers and continuous channel electron multipliers indicate that the noise can always be described as the product of the multiplied primary shot noise and a noise deterioration factor. The deterioration factor is comparable in all cases. The first two devices have a linear relative between output and input, but the channel multiplier is nonlinear. One must then distinguish between the true and apparent noise reduction factors. The latter can be quite small and it gives an inflated idea about the multiplier performance. Author (TAB)

N68-13096# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MICROELECTRONIC ELEMENTS IN SHIP AUTOMATION
A. P. Makarov 18 Aug. 1967 17 p Transl. into ENGLISH from Morskoi Sb. (Moscow), no. 8, 1965 p 70–76
(FTD-MT-66-80; AD-661394)

A review of the foreign progress in miniaturization of electronic circuits is presented. To provide increased reliability, to save cost, size weight, and to accelerate development work, electronic construction evolved from separate production of each element to unit construction of subassemblies, while semiconductor devices replaced tubes. Today, much construction is based on thin film and solid (integral) circuits, and microminiaturization will be further extended by the development of molecular electronics. In the thin film circuits, 200-500 A layers of metal, dielectric, and insulating materials are alternately deposited on ceramic or glass bases. The deposition can be done by thermal vaporization, by cathode sputtering, or by electromechanical plating. The greatest difficulty stems from the fact that transistors, diodes, and high-rated capacitors for inductance cannot be included in the film. In the solid circuits the electronic components are embedded in or attached to the surface of a semiconductor crystal, which is a system of n-p junctions of a specified geometry. In molecular electronics the fundamental units are designed on the bases of the magnetic and electric fields, of the spin and interaction values of the voltage field, and of the charges inside the crystal lattice. The Seebeck, Peltier, and Hall effects are used in this work. Molecular electronics permits a component density 100 times greater than that of solid circuits. Author (TAB)

N68-13230# Radio Corp. of America, Lancaster, Pa. Electronic Components and Devices.
A CdSe BISTABLE SWITCH Final Report, May 1966–Jul. 1967
Stanley A. Harper and Lawrence J. Nicastro Griffiss AFB, N. Y. RADC Oct. 1967 143 p refs
(Contract AF 30(602)-4190)
(RADC-TR-67-490; AD-661597)

Under certain conditions of synthesis, cadmium selenide (CdSe) shows a hysteresis effect in its current-voltage relationship. The material, therefore, has been of interest for use as a switch to control the electroluminescent (EL) emission of a solid state display device. Some of the major problems associated with this hysteresis effect were the poor reproducibility of the CdSe synthesis and the non-uniformity of the electrical characteristics. The purpose of this program was to study the procedure for synthesizing hysteretic CdSe powder with the goal of achieving the required uniformity during electrical operation. The synthesis of CdSe powder (with hysteresis) is an extremely complex process consisting of three firing steps. Each of the firing steps was studied in detail to determine which parameters were most important in the synthesis. It was found that an oxygen-containing atmosphere was necessary during a high temperature firing to produce the hysteresis effect. Without this firing step, the conductivity could be reduced upon subsequent lower temperature firings in oxygen or selenium atmospheres, but the hysteresis would be absent. The second and third firing steps were found not to be as critical as the first step. As a result of these studies, modifications were made in the firing procedures which permitted the syntheses of hysteretic materials with relatively good reproducibility. The quality of hysteresis of many selected CdSe samples was approximately equivalent but the ranges in threshold and cutoff voltages were not sufficiently narrow to attain the required electrical uniformity. Models with 1024 elements in a 32 x 32 array were constructed during the program. Author (TAB)

N68-13242# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HANDBOOK OF SEMICONDUCTOR DEVICES

V. Yu. Lavrinenko 13 Mar. 1967 345 p refs Transl. into ENGLISH of the book "Spravochnik Po Poluprovodnikovym Priboram" Kiev, Tekhnika, 1964 p 1–323
(FTD-HT-66-686; AD-661896)

The handbook contains data on the basic types of thermistors, photoresistors, selenium and copper-oxide rectifiers, germanium and silicon diodes, planar germanium and silicon transistors, with an indication of the field of their application. This handbook is intended for engineers, technicians and radio hams working in the field of semiconductor device application and it may also be useful for students studying such devices. Its purpose is to assist specialists working in the field of semiconductor device application. Its presentation assumes that the reader is familiar with the fundamentals and characteristics of semiconductor circuits. The initial portion of each chapter presents reference data on the general characteristics of the given class of semiconductor devices, the salient features of their use, and the definitions of the basic parameters used. Reference data on the particular types of devices are then presented. Author (TAB)

N68-13367# Army Electronics Labs., Fort Monmouth, N. J.
HIGH-POWER, Y-JUNCTION E-PLANE CIRCULATOR
William H. Wright, Jr. and Joseph W. McGowan Oct. 1967 9 p ref
(ECOM-2883; AD-661637)

A symmetrical, Y-junction, E-plane circulator, capable of handling in excess of 500 kW peak and 670 watts average power, is described. The circulator operates at a frequency of 9375 MHz. A circular hole with a length equal to the broad dimension of the waveguide forms the junction of the three waveguide ports. Ferrite discs are mounted at the center of the junction on the narrow wall of the waveguide. The magnetic biasing field is applied along the axis of the discs. Materials tested were pure polycrystalline YIG, 2% dysprosium, 4% dysprosium, 8% dysprosium doped polycrystalline YIG, and 4% dysprosium with 30% gadolinium doped polycrystalline YIG. The insertion loss and the isolation at the power levels mentioned depended on the material used. Measurements at high power showed an insertion loss of 0.8 dB and an isolation of 15 to 16 dB to be the best obtainable results using 4% dysprosium gadolinium doped materials. Data on insertion loss as a function of peak power are presented. Author (TAB)

N68-13408*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A STEPPING MOTOR DRIVE CIRCUIT FOR SPACE APPLICATIONS
Joseph C. Thornwall Nov. 1967 23 p
(NASA-TM-X-63065; X-614-67-586) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This paper describes a new magnetic core circuit that is used to supply power in the proper phase and time sequence to a bi-directional stepping motor. This circuit will power a standard voltage stepping motor from a non-standard voltage power supply and includes a means for maintaining a constant energy pulse excitation over a wide range of d–c power supply input voltage, a means for supplying power to the winding of the motor on pairs of isolated conductors and a means for conductively isolating the low level logic circuits from the high level power circuits. Author

N68-13620* Wyle Labs., Inc., Huntsville, Ala. Testing Div.
THE DETERMINATION OF VOLTAGE AND TEMPERATURE VALUES FOR POLYCARBONATE CAPACITOR AC LIFE TESTS Final Report
W. C. Dysart 26 Jul. 1967 64 p
(Contract NAS3-7623)
(NASA-CR-72297) CFSTI: $3.00 CSCL 10C

Polycarbonate film-and-foil and metallized polycarbonate film capacitors were subjected to a 300-hour test consisting of selected environmental temperatures and test potentials. The applied test potentials consisted of ac square wave voltages at a frequency of 400 hertz. The magnitude of these voltages and temperatures were designed to force failures within the 300-hour test period. The results provide the necessary information for the selection of test parameters for a 5000-hour ac life test. Author

N68-13617*# Stanford Research Inst., Menlo Park, Calif.
MICROWAVE TECHNIQUE DEVELOPMENT FOR ADVANCED RADIO ASTRONOMY AND RADIOMETRY MISSIONS
B. M. Schiffman and Leo Young Washington NASA Jan. 1968 78 p refs
(Contract NAS12-126)
(NASA-CR-979) CFSTI: HC $3.00/MF $0.65 CSCL 09A

A scale model (f_o=20 GHz) of a birefringent wave filter for millimeter wavelengths is described. The filter consists of five cascaded identical half-wave plates, or crystals, each composed of an artificial anisotropic dielectric medium with its reference axis tilted at some prescribed angle to the plane of the input polarization. The design and analysis of an individual plate and the analysis of multielement filters are discussed. The experimental filter was tested in the range of 18–33 GHz, and its measured performance was found to compare well with the theoretical performance over a major portion of the range of frequencies used in the tests. A synthesis procedure for optimum (equal-ripple stop band) response multielement filters is given, together with tables of plate angles for such filters. This procedure combines the Fourier approximation method with the general synthesis method. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-12992*# California Inst. of Tech., Pasadena.
APPLICATION OF MODERN CONTROL AND NONLINEAR ESTIMATION TECHNIQUES
R. Sridhar, A. K. Bejczy, K. S. P. Kumar, G. R. Ash, W. P. Charette et al Dec. 1967 233 p refs Prepared for JPL
(Contracts NAS7-100; JPL-69821; JPL-69822)
(NASA-CR-91441) CFSTI: HC $3.00/MF $0.65 CSCL 09C

In the area of optimal guidance of low thrust interplanetary spacecraft, the formulation and solution of deterministic and stochastic problems are described, and an analysis is given of guidance system accuracy for a constant thrust, minimum time Mars rendezvous mission. Optimal thrust programs, obtained by applying the Pontryagin maximum principle in the form of switched functions, are used for the control of spacecraft in one and two degrees of freedom during controlled soft landings in imperfectly known atmospheres. Open and closed loop solutions for the minimum energy control of electrically propelled vehicles are considered together with various types of terminal constraint controllers. Sensitivity considerations for feedback controls are discussed in terms of mini-max design criteria based on performance indexes and trajectory deviations. E.I.S.

N68-13013# Air Force Cambridge Research Labs., Bedford, Mass. Data Sciences Lab.
SINGLE TEE AND PI TWO-PORTS, RESISTIVELY TERMINATED AND HAVING A PRESCRIBED DRIVING-POINT IMMITTANCE
Kurt H. Haase Jul. 1967 18 p refs Presented at the 10th Midwest Symp. on Circuit Theory, Lafayette, Ind., 18–19 May 1967 *Its* Phys. Sci. Res. Papers No. 333
(AFCRL-67-0430; AD-661560)

Biquadratic, biquartic, bisextic, in general terms bi-order-n positive real immittance functions can be realized as driving-point immittances of a Tee or a Pi section that is terminated with a resistance, provided that the function belongs to a certain subclass of positive real and bi-order-n functions. This general principle is discussed particularly for biquadratic and biquartic functions. It is shown that the Tee and the Pi circuits implying a negative immittance of the rank $2m + 1$ can be transformed into another circuit that instead of the negative immittance implies a resistance as the only negative branch element. Author (TAB)

N68-13028# Royal Aircraft Establishment, Farnborough (England).
DETERMINATION OF STABILITY BOUNDARIES USING LIAPUNOV FUNCTIONS AND NUMERICAL MINIMISATION
R. P. Muddle Jul. 1967 13 p refs
(RAE-TR-67148; AD-661179)

The Liapunov approach to stability analysis is presented. A technique using numerical minimisation is developed for rapid computer evaluation of regions of asymptotic stability for given Liapunov functions. Author (TAB)

N68-13098# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE PROBLEM OF OPTIMUM CONTROL OF A COMPLEX OF INSTRUMENTS
Yu. A. Rozanov 21 Apr. 1967 24 p refs Transl. into ENGLISH from Tr. Akad Nauk SSSR, Ser. Mat. (Moscow), v. 71, 1964 p 88–101
(FTD-HT-67-41; AD-661376)

The paper treats the problem of obtaining a minimum variance unbiased estimate, given n unbiased observations on a quantity whose value does not influence the distribution of error. TAB

N68-13104# RAND Corp., Santa Monica, Calif.
CONTROL WITH STOCHASTIC STOPPING TIME
Allen Klinger Nov. 1967 24 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5342-PR; AD-661541)

The usual (nonstochastic stopping) control problem is extended to include the case of random terminal time. Systems which are otherwise deterministic, and systems with additive noise in the dynamic equation are considered. Results concerning the relevant aspects of reliability and Markov process theories are presented. Author (TAB)

N68-13165# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIOELECTRONIC MEASUREMENTS
G. Ya. Mirskiy 20 Apr. 1967 648 p refs Transl. into ENGLISH of the book "Radioelektronnyye Izmereniya" Moscow, Gosenergoizdat., 1963 p 1–528
(FTD-HT-66-286; AD-661890)

Contents: Signal sources and UHF elements of measuring systems, UHF elements of measuring systems, Measuring oscillators; The measurement of the parameters and of the characteristics of the signals, Study of the voltage form, Measurement of time intervals, Voltage measurement, Measurement of power, Frequency measurement, Phase shift measurement, Investigation of spectra and nonlinear distoritions; Measurement of probability distribution and characteristics of random processes, Measurement of the values of the probability distribution function and density, Measurement of random process characteristics; Measurement and monitoring of radioelectronic circuit element parameters, Parameter measurement and control of the elements of circuits with lumped constants, Measurement of the parameters of the linear elements of super-high frequency channels; Problems of measurement automatization, Acceleration of measurements and reduction of their difficulties, Basic features of full measurement automatization. TAB

N68-13231* Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
DESIGN OF MICROELECTRONIC CIRCUITS Final Report
Feb. 1967 72 p
(Contract NAS12-16)
(NASA-CR-86016) CFSTI: $3.00 CSCL 09C

A Monte Carlo computer analysis technique is described for predicting the reliability and yield of functional integrated circuit low-power operational amplifiers. Room temperature electrical measurements were made on each device to determine the conformance with a given set of electrical specifications. A cumulative probability distribution for each performance parameter was prepared for comparison with the computed results obtained using measured distribution of individual element values and the circuit design equations. The program involves the preparation of histograms for each process variable as input to the computer; the specification of the acceptable range of values for each electrical performance characteristic (output); and the determination of nominal and extreme values for operating condition parameters. The circuit design equations used by the computer to calculate performance are listed, and the actual computer output is presented. The results are assessed, and it is pointed out that the seven parameters treated in the analysis, two were well predicted in terms of variance and mean values. M.G.J.

N68-13311*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
[THEORETICAL AND EXPERIMENTAL STUDIES OF SUB-OPTIMAL SECOND AND THIRD GENERATION SELF-ADAPTIVE BINARY COMMUNICATION SYSTEMS] Semiannual Report, 1 Jul.–31 Dec. 1967
John C. Lindenlaub 31 Dec. 1967 21 p refs
(Grant NsG-553)
(NASA-CR-91526) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A summary is presented of research on the effects of frequency selective fading on binary digital communications and a method to alleviate such effects. Other research summaries deal with techniques for analog communication over selective fading channels, digital communication over frequency selective channels, and a phase lock loop system with a modulo $2\pi r$ phase detector. Source encoding of weather satellite data, synchronization and bit timing, PCM telemetry systems, and an experimental digital filter are also considered in relation to suboptimal second and third order generation self-adaptive, binary communication systems. M.W.R.

N68-13330 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE OPTIMAL CONTROL PROBLEM [OB ODNOY ZADACHE OPTIMAL'NOGO UPRAVLENIYA]
B. G. Pittel' *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 85–102 refs
(See N68-13323 04-19)

This analysis of the problems of optimal control uses the Pontryagin maximum principle to prove a theorem similar to the one on the finiteness of the number of changes in linear optimal variations. A second order equation with two controlled parameters is investigated in detail. An example is given showing that in optimal control problems variable optimal control is possible. The problem of optimal high-speed control of an object is considered. Author

N68-13369# Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands).
ANALOGUE AND DIGITAL METHODS FOR INVESTIGATING ELECTRON-OPTICAL SYSTEMS
C. Weber (Tech. Hogeschool, Eindhoven) Feb. 1967 88 p refs
Its Res. Rept. Suppl. No. 6

This paper is divided into three parts, dealing with the analogue computation of potential fields using resistance networks, the digital computation of potential fields, and the computation of electron beams, respectively. In the first part resistance networks are treated for the solution of the Laplace equation with rotational symmetry. In the part dealing with the digital computation of potential fields a short survey is given of the theory of successive overrelaxation. In the last part special attention is paid to the influence of the space charge and the transverse thermal velocities. A preparatory study is made of a thin, generally curved beamlet, consisting of electrons leaving the cathode with a Gaussian thermal velocity spread. Author

N68-13451 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
ON THE DISTRUBANCE MINIMIZATION IN A SPECIAL LINEAR SINGLE-LOOP SYSTEM [UEBER DIE OPTIMALE UNTERDRUECKUNG VON STOERSIGNALEN IN EINEM SPEZIELLEN EINLAEUFIGEN LINEAREN SYSTEM]
M. Rodewald Apr. 1967 33 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-32)

By using various performance indices to evaluate the effect of disturbance minimization on a control loop, it has been shown that, if any, the integral squared error can be calculated by using formulae derived from Parseval's Theorem. Also, efforts were made to determine clear and simple relationships between the compensator and the loop performance; this is important for cases where simple minimization criteria prove unsatisfactory. By suing a plot similar to the Nichols chart, some simple rules have been derived by which the closed-loop frequency response can be determined from the open-loop Bode plot. Author

N68-13616*# Information Dynamics Corp., Reading, Mass.
NASA MICROELECTRONICS DATA BANK PILOT PROGRAM. VOLUME 1: MANAGEMENT SUMMARY AND TECHNICAL EVALUATION
Oct. 1967 110 p refs
(Contract NAS12-147)
(NASA-CR-86018; R-8090-3, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This volume reports on results of the pilot test to evaluate the ability of the designed NASA Microelectronics Data Bank to respond to user queries, in an accurate and timely manner, under actual operating conditions. The feasibility and acceptability of the Data Bank design and its operational services were verified during the pilot test. The critical need for a micro-electronics data communications system was also verified, and it was demonstrated that the Data Bank has the ability to be responsive to this need. There was widespread agreement that the Data Bank's output products effectively performed their intended functions. All of the goals and objectives of the Pilot Program were realized. This report recommends that an operational microelectronics data bank be implemented as soon as technically feasible and that specific steps be taken in order to arrive at a level of operational readiness. Author

N68-13804*# Stanford Univ., Calif. Radioscience Lab.
A REAL-TIME DIGITAL SPECTRUM ANALYZER
R. B. McCullough Nov. 1967 137 p refs
(Grant NsG-377)
(NASA-CR-91530; SEL-67-099; SR-23) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This research develops a new algorithm for digital spectral analysis in real time. This new algorithm is intended for implementation by special-purpose circuitry using currently available integrated circuits. Maximum sampling rates above 1 MHz can be realized in continuous real-time operation. This is much faster than any other existing algorithm can operate. A closed-form analytical expression is developed for the passband characteristics of the discrete Fourier transform operation. This expression is used to evaluate in detail the effectiveness of several time-domain and frequency-domain operations aimed at improving the passband characteristics. A hardware design is presented which makes use of certain novel features of this new real-time algorithm. Among these features is the use of shift registers in which only the inputs and outputs are available. This permits use of very long integrated circuit shift registers in very small packages since very few inputs and outputs are required. This feature would not be an advantage in realizing this algorithm in a general-purpose computer, but it definitely is in special-purpose hardware. Author

N68-13807*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SIMULATION STUDY OF A PRECISE HYBRID SERVO CONTROL SYSTEM
George C. Winston and William H. Long Sep. 1967 25 p refs
(NASA-TM-X-63088; X-525-67-495) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This report describes an analog computer simulation study of a precise hybrid (digital-analog) servo control system designed to control an experimental optical tracking mount. The control concept developed for this system was relatively unique at the time of its inception (March 1963) and no references to performance of similar systems were known. As a consequence a detailed simulation study was performed. This study indicated the soundness of the concept (since confirmed experimentally) and demonstrated a tracking capability well within the two arc second specification. Techniques were developed and demonstrated in the simulated system for overcoming nonlinear effects of amplifier saturation and coloumb friction. Author

N68-13898*# Massachusetts Univ., Amherst. Engineering Research Inst.
A DIGITAL COMPUTER PROGRAM FOR CONTROL SYSTEM ANALYSIS
B. W. Lovell 17 Aug. 1967 30 p
(Grant NGR-22-010-018)
(NASA-CR-91504; Rept.-4) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Lovell is a digital computer program for the analysis of control systems. The program will handle PFM units, PWM units, zero order sample and hold units, and delay functions, as well as simple continuous systems. The user of Lovell must supply the system equations to the program through a subroutine using state variable techniques. All of the differential equations are solved by

a fourth order Runge–Kutta method, with the basic mesh size supplied by the user. Program Lovell has the capability of restarting a solution, or starting a solution, at a time other than zero. Also, through a subroutine, problems may be stacked. This allows more than one problem to be solved with only one computation, thus saving computer time. Numerous sample problems are included. The data and necessary subroutines are shown for each problem. The program is written in CDC 3600 Fortran. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-12860*# ITT Industrial Labs., Fort Wayne, Ind.
IMAGE DISSECTOR CAMERA SUBSYSTEM, ASSOCIATED GROUND SUPPORT EQUIPMENT, AND INTEGRATION SUPPORT FOR APPLICATIONS TECHNOLOGY SATELLITE Quarterly Report, Nov. 17, 1966–Feb. 17, 1967
7 Sep. 1967 10 p
(Contract NAS5-10200)
(NASA-CR-91350; ITTIL-67-1045; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Fabrication of flight model circuit boards and other subassemblies is reported, along with the completion of printed circuit assemblies for the flight camera and the initiation of module testing. Fabrication and construction work on the ground support unit was also completed, and additional design and development effort was directed toward the nutation correction technique and its circuitry. The sample and hold circuit for this correction circuit was refined, and its configuration is depicted. M.G.J.

N68-13358 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany). Inst. fuer Angewandte Gasdynamik.
THE DVL PLASMA WIND TUNNEL PK1, A FACILITY FOR HYPERSONIC VELOCITIES, LOW DENSITIES AND HIGH TEMPERATURES [DER DVL-PLASMAWINDKANAL, EINE ANLAGE FUER HYPERSONISCHE GESCHWINDIGKEITEN, GERINGE DICHTEN UND HOHE TEMPERATUREN]
M. Becker and A. Heyser Oct. 1967 62 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-66; DVL-669)

The regime of the arc heated low density hypervelocity wind tunnel is discussed. Reservoir pressures between 0.3 and 3 at and reservoir temperatures between 1500 and 8000°K are obtained to date. In the test section Mach numbers are varied between 5 and 20 and interaction parameters $M\infty/R\infty^{1/2}$ between 0.2 and 2 $cm^{1/2}$. The construction of the wind tunnel, the design of the most essential parts and the development of the instrumentation is mentioned. First measurements made in an argon stream at Mach numbers from 12 to 20 are reported. Author

N68-13402# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
RESUME OF THE SINGLE AXIS SIMULATOR, ITS PURPOSE AND FUNCTION IN THE L.A.S. PROJECT
B. Sunesson Paris ESRO Dec. 1966 13 p refs
(ESRO-TM(P)-76) CFSTI: HC $3.00/MF $0.65

A dynamic simulator is defined as a testing tool using a real structure in order to simulate the dynamic behavior of the Large Astronomical Satellite. A brief resume of the single axis simulator with a reference to a number of other papers is presented. Its purpose, development, and manufacture are briefly described. Author (ESRO)

N68-13404# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
THE COVERAGE OF VARIOUS GROUND STATIONS
H. Martinides Paris ESRO Dec. 1966 10 p
(ESRO-TM(P)-85) CFSTI: HC $3.00/MF $0.65

The information presented gives the coverage of various ground stations for a satellite in a circular orbit and with a perigee of 650 km. The coverage of ten ground stations has been evaluated and plotted on a world map for contact times equal to 0, 3, 5 and 7 minutes. Author (ESRO)

N68-13405# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
THE SINGLE AXIS SIMULATOR BEARING Progress Report, 15 Oct. 1966
H. M. Briscoe Paris ESRO Nov. 1966 6 p
(ESRO-TM(P)-72) CFSTI: HC $3.00/MF $0.65

The base, lifting mechanisms, and the Elliott gas bearing had been assembled and were in the process of development measurements when operations were halted by the fire at ESTEC in October 1966. This report is an effort to write down from memory some of the assembly and development steps with test results (dynamic characteristics of the bearing, determination of the nature of oscillation with a Wayne Kerr vibration meter etc.). It may help for the reassembly and the rebuilding of the large Astronomical Satellite. Author (ESRO)

N68-13446# Naval Ordnance Lab., White Oak, Md.
THE NOL VAN DE GRAAFF FACILITY
Albert E. Evans, Jr. and Donald G. Simons 28 Jun. 1967 143 p refs
(NOLTR-67-102; AD-661794)

The Naval Ordnance Laboratorys 2.5 MeV Van de Graaff positive-ion accelerator is described. This machine was originally a 2 MeV x-ray generator built for the Navy in 1943 by MIT Laboratories. The design of the present facility and technical problems connected with conversion and updating of the machine are discussed. Instructions are given for its operation and maintenance. Author (TAB)

N68-13456 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.
THREE-COMPONENT FORCE MEASUREMENTS AT THE AGARD CALIBRATION MODEL B IN THE LARGE SUPERSONIC WIND TUNNEL OF THE DFL [DREIKOMPONENTENMESSUNGEN AM AGARD-EICHMODELL B IM GROSSEN UEBERSCHALL-WINDKANAL DER DFL]
H. Koester Jun. 1967 35 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-46)

The test setup for three-component force measurements at the AGARD calibration model B in the large supersonic wind

tunnel of the DFL (test section 50 cm by 50 cm) is described. The obtained test results for the Mach number range from Ma_∞ = to 4 are compared with those from other wind tunnels. The measured values are considered to be in good agreement. Author

N68-13457 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Aerodynamik.
CALIBRATION OF THE LARGE SUPERSONIC WIND TUNNEL OF THE DFL (TEST SECTION 50 CM BY 50 CM^2) [EICHUNG DES GROSSEN UEBERSCHALL-WINDKANALS DER DFL (MESSQUERSCHNITT 50×50 CM^2)]
H. Koester Jun. 1967 60 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-45)

The quality and usefulness of a wind tunnel depends essentially on the properties of the flow in the test section. After a brief description of the 50 cm by 50 cm supersonic wind tunnel with a Mach number range between Ma = 1.5 and 4.0 and the used probes and technique of measurement the results of calibration are presented. The measurements comprise the determination of the starting and minimum operation pressure ratios as well as the Mach number and the flow-angle distribution in several cross-sections at right angle to the wind tunnel axis. The starting pressure ratio is essentially higher than the minimum operation pressure ratio which has the same order of magnitude as other wind tunnels. The average Mach numbers in the different cross-sections vertical to the wind tunnel axis alter about ±0.5 percent while the average flow-angles deviate about 0.1 to 0.2 deg from the nozzle axis. The maximum running time depends on the operating conditions and ranges from 20 to 120 seconds. Author

N68-13555 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Institut fuer Strahlantriebe.
STUDIES FOR A MAXIMUM SPEED WIND TUNNEL FOR RE-ENTRY CONDITIONS RESEARCH [STUDIE UEBER EINE HOECHSTGESCHWINDIGKEITSVERSUCHSANLAGE FUER WIEDEREINTRITTSUNTERSUCHUNGEN]
P. Nitsch, E. Riester, and N. Schmidt 26 Apr. 1967 29 p In GERMAN; ENGLISH summary
(DLR-Mitt.-67-11)

The lay out of a maximum speed windtunnel for re-entry conditions with sufficient running time and rather good simulation of real gas effects is studied. Recent test results concerning parts of the test facility are given. The installation of the test plant could be made most economical by using a hot water supply as energy source for producing electric power and for the suction side of the tunnel drive. Author

N68-13755# Stanford Univ., Calif. Linear Accelerator Center.
BEAM BREAK-UP AT SLAC Progress Report
E. V. Farinholt, R. H. Helm, H. A. Hogg, R. F. Koontz, G. A. Loew et al Sep. 1967 20 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967
(Contract AT(04-3)-515)
(SLAC-PUB-350; CONF-670930-6) CFSTI: HC$3.00/MF$0.65

The progress made in the last six months in understanding and remedying the beam breakup effect (BBU) at SLAC is reported. The experimental and theoretical approaches to the BBU problem are discussed. The present hypotheses on noise sources (klystron noise power, gun shot noise power, and shock excitation) are described. NSA

N68-13756# Stanford Univ., Calif. Linear Accelerator Center.
THE SLAC ACCELERATOR: FIRST YEAR OF OPERATION
G. A. Loew, R. B. Neal, and E. Seppi Sep. 1967 22 p refs Presented at the 6th Intern. Conf. on High Energy Accelerators, Cambridge, Mass., 11–15 Sep. 1967
(Contract AT(04-3)-515)
(SLAC-PUB-351; CONF-670930-7) CFSTI: HC$3.00/MF$0.65

The performance achieved at SLAC during the first full year of operation is summarized. Some of the improvement programs now underway are briefly discussed. NSA

N68-13815 Technische Hochschule Munchen (West Germany). Fakultaet fuer Bauwesen.
SUPERCRITICAL FLOW IN OPEN CHANNELS WITH SPREAD OUT CONSTRICTIONS [SCHIESSENDER ABFLUSS IN OFFENEN GERINNEN MIT FAECHERFOERMIGER VERENGUNG]
Jost Knauss (Ph.D. Thesis) 1967 72 p refs In GERMAN
(Rept.-9)

Theoretical and engineering studies for the construction and evaluation of a chute spillway model for flood water dams are presented. Gas dynamic methods are employed to obtain the supercritical parameters of the open channel hydraulic flow, and the slope and friction effects associated with high speed flows. Measurements on a horizontal dam model with fan-like chute spillway arrangement established the economic necessity to restrict flow channel contractions to not more than 1/3 of the entrance width and slope angle to about 40°. Transl. by G.G.

N68-13828 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
TESTING SYSTEM OF HELICOPTER ROTORS IN THE WIND-TUNNEL OF MODANE TESTING CENTER [INSTALLATION D'ESSAIS DE ROTORS D'HELICOPTERES DANS LA GRANDE SOUFFLERIE DE MODANE-AVRIEUX]
Andre Schweisch [1964] 10 p refs In FRENCH; ENGLISH summary

A testing system for helicopter rotors and S/VTOL propellers is described. It is used in one of the 8 m. removable test-sections of the sonic wind-tunnel S1 at the Onera Testing Center, Modane. This system allows testing large diameter rotors whose axes can be rotated in the vertical plane such that $-95° < \alpha_s < +25°$. The test-section is 8 m in diameter and 14 m in length. The maximum useful power is 736 kW and the rotor rotation rate can be continuously varied from 800 r.p.m. to 2300 r.p.m. A braking device allows autorotation testing. A six-component balance supports the hub of the rotor and measures the resulting aerodynamic torque. A collector, including 50 rings, provides the electric outputs from the rotating parts of the rotor (loads on the pitch-control rods, local pressure on the blades, main stresses). The blade wake can be explored, and a stroboscopic device allows detection of blade deformation. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-12814# General Dynamics/Convair, San Diego, Calif. Space Science Lab.
THE MULTITUBE SUPERSONIC FLOW COMPUTER CODE

F. P. Boynton Feb. 1967 141 p
(Contract Nonr-3902(00); Proj. Defender)
(GDC-DBE67-003; AD-661213)

The report describes a Fortran IV computer program which calculates supersonic flow fields with viscous effects. The code is based on a Lagrangian finite-difference technique in which the computational grid is composed of streamlines and the surfaces orthogonal to them, and can be applied to two-dimensional or axially symmetric flows. Viscous transport in the direction normal to streamlines is included. Diffusive effects are treated with the full multicomponent and pressure diffusion formalism; thermal diffusion is treated approximately. Boundary conditions which may be treated include solid walls, free boundaries at given pressures, free boundaries with Newtonian impact pressures, or shocks propagating into known external flows. Multiply shocked flows may be treated by successive runs of the program. Instructions for preparing input to the program are given. Sample inputs for several different types of flow are presented, together with results of the calculations at a few downstream locations. Author (TAB)

N68-12851 Royal Aircraft Establishment, Farnborough (England).
FRICTION LOSSES IN NON-STEADY LAMINAR FLOW IN PIPES [POTERI NA TRENIE PRI NESTATSIONARNOM LAMINARNOM TECHENII V TRUBAKH]
N. A. Panchurin Aug. 1967 13 p refs Transl. into ENGLISH from LIVT. Trans., v. 77, 1964 p 38–43
(RAE-LIB-TRANS-1244) CFSTI: $3.00

Use is made of the Navier–Stokes fluid flow equation, in a case of nonsteady isometric motion, to examine the problem of energy losses by friction. An attempt to determine pipe friction coefficients from known velocity profiles is shown to give rise to unreliable results due to insufficiently precise definitions of motion coefficient and mean velocity. An experimental technique for the determination of friction coefficients is discussed from which the assumption is made that the character of the change of pressure losses under nonsteady, as compared with steady, conditions, will be determined solely by the form of the flow (accelerated or decelerated). Author

N68-12892*# IIT Research Inst., Chicago, Ill.
EVALUATION OF TURBULENCE CORRELATIONS IN A COAXIAL FLOW OF DISSIMILAR FLUIDS
Antonio Montealegre, Gerard J. D'Souza, and Herbert Weinstein Washington NASA Jan. 1968 85 p refs
(Grant NsG-694)
(NASA-CR-961) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A method of measuring fluctuations in velocity by means of a hot wire anemometer system has been developed and applied in a flow field where large concentration gradients exist. The flow field chosen is a coaxial flow of the two dissimilar fluids with a density ratio of 4:1. The fluid medium is air and the other fluid is Freon-12. The new method based on the use of an aspirating density probe in conjunction with the parallel wires, when applied to coaxial flow data, give values that are reasonably damped with respect to density fluctuations. Also, these correlations are found to be inapplicable in certain mean velocity ranges, i.e., at low and very high velocities. Results of calculations of velocity, density and fluctuations in velocity and density in coaxial flow of the air–freon system are presented and discussed. Author

N68-12967 Aeronautical Research Council (Gt. Brit.)
THE DISTRIBUTION OF A WALL PRESSURE RISE IN A TURBULENT BOUNDARY LAYER
R. J. Herd London HMSO 1967 44 p refs Supersedes NGTE-R-275; ARC-27733 See X68-16017
(ARC-CP-967; NGTE-R-275; ARC-27733) HMSO: 6s 6d

An expression is derived for the wall pressure gradient in attached flow with both compressible and incompressible turbulent boundary layers. From this gradient, the pressure distribution may be determined by an integration process. The agreement with experiment is considered encouraging. Of the various potential applications of this technique, separation is here considered. Author

N68-12976# New York Univ., N. Y.
A CRITICAL REVIEW OF HETEROGENEOUS MIXING PROBLEMS
Antonio Ferri Wright-Patterson AFB, Ohio ARL Sep. 1967 49 p refs
(Contract AF 33(615)-2215)
(NYU-AA-67-102; ARL-67-0187; AD-661547)

A critical review of mixing problems is presented. The limitations of boundary layer types of analyses are discussed. A method of analysis which does not use boundary layer approximation is outlined. Difficulties of correlating experimental data attributable to not-well defined boundary conditions are described. New phenomena related to mixing with pressure gradient and chemical reaction are presented. Author (TAB)

N68-12981# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF MASS TRANSFER ON A WEDGE INDUCED LAMINAR SEPARATED BOUNDARY LAYER AT MACH 12 Final Report, Feb. 1965–Dec. 1966
Karlheinz O. W. Ball (Ph.D. Thesis—Univ. of Southern Calif.) Aug. 1967 135 p refs
(ARL-67-0169; AD-661545)

The essential two-dimensionality of the flow was verified by comparing surface pressure and heat transfer results with small fences just covering the region of separation to results obtained without fences. The symmetry of the configuration also helped to minimize end effects. Surface pressure measurements at a wall to stagnation temperature ratio of 0.56 and heat transfer measurements at a wall to stagnation temperature ratio of 0.28 were made for aft-wedge deflection angles of 0, 5, 10, 15 and 20 degrees with variable suction obtained for each angle by varying the corner slot width. The extent of separation is shown to be extremely sensitive to suction. Removal of a small percentage of the boundary layer mass flow is sufficient to collapse the separated flow region for the present configuration. The effect of the suction is to remove the low momentum flow near the wall, thus enabling the remaining shear layer to negotiate a higher compression at reattachment. Author (TAB)

N68-12994# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
A THEORETICAL-EXPERIMENTAL STUDY OF THE EFFECT OF VISCOSITY ON WAVE RESISTANCE Final Report
King S. Eng and John P. Breslin Oct. 1967 39 p refs
(Contract Nonr-263(65))
(Rept.-1236; AD-661486)

The problem of assessing the effect of viscosity on wave resistance is considered. The approach is to regard the decisive effect of viscosity as stemming from the difference between the measured pressure distribution on the stern and that predicted by inviscid-flow theory. Results based on the linearized theory show that the pressure deficiency at the stern of the body has little or no effect in the determination of wave resistance. Indications are that the pressure distribution around the mid-portion of the body makes the important contribution to wave resistance. Author (TAB)

N68-12895 Aeronautical Research Council (Gt. Brit.)
SOME FURTHER NOTES ON THE LAMINAR BOUNDARY LAYER DEVELOPMENT AND RUNNING TIME IN A SHOCK TUBE
J. A. D. Ackroyd London HMSO 1967 46 p refs Supersedes ARC-28457 See X67-16727
(ARC-CP-966; ARC-28457) HMSO: 8s 6d

An earlier analysis of the laminar boundary layer development aft of a shock wave in a shock tube is corrected in the light of more recent theoretical results. The analysis is extended to include certain pressure gradient corrections. The corrected results show a significant change in boundary layer characteristics and running time. The effects of the additional pressure gradient corrections are shown to be negligible. Author

N68-13049# Stanford Univ., Calif. Dept. of Civil Engineering.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF THE AIR VELOCITY PROFILE ABOVE PROGRESSIVE WAVES
Omar H. Shemdin Jul. 1967 64 p refs
(Contract Nonr-225(71); Grant NSF GK-736)
(TR-82; AD-661479)

The influence of propagating waves on the mean velocity profile is sought especially. Both the instantaneous and mean velocity profiles were obtained with the use of high response total head and static pressure probes, in conjunction with a wave height gage. Experimental evidence is presented which suggests that the air velocity responds to the wave motion at the air-water interface. The dependence of the mean velocity profile on wave frequency is investigated over mechanically-generated waves having a constant amplitude. Also the dependence of the mean velocity profile on wave amplitude is investigated over mechanically-generated waves with a specified frequency. The results are viewed in light of a theoretically constructed velocity profile which incorporates the effect of wave-induced motion. The theoretical results suggest that the measured mean velocity profile is influenced by the wave motion in a vicinity of approximately three wave amplitudes above the mean water surface. The results also suggest that the wave influence is twofold. The first is due to the fact that a velocity measuring instrument continuously shifts streamlines when measuring the air velocity above a perturbed water surface. The second is due to the wave-induced perturbation in the air velocity. Author (TAB)

N68-13109# Stanford Univ., Calif. Dept. of Civil Engineering.
SPECTRAL MEASUREMENTS AND GROWTH RATES OF WIND-GENERATED WATER WAVES
Alex J. Sutherland Aug. 1967 76 p refs
(Contract Nonr-225(71); Grant NSF GK-736)
(TR-84; AD-661480)

Power spectral density measurements were made of the water surface displacement in a wind-generated wave train in the Stanford Wind, Water-wave Facility. Two of the more interesting features of the measured spectra--the presence of a second peak and the lack of an equilibrium range--are fully discussed. Growth rates of different wave components were determined from the measured spectra. The resulting values were compared with those predicted by the viscous Reynolds stress mechanism of energy transfer from wind to wave which was proposed by Miles. Where the growth was exponential the theory could be made to predict growth rates successfully at wave numbers less than 15.0 ft(-1). At higher wave numbers the theory predicted values an order of magnitude larger than those measured in the Stanford facility. Limited regions of linear growth were found at the lowest wind speed for low frequency components. The scatter in the data did not permit a quantitative comparison with theory to be made for this range. Author (TAB)

N68-13110# North American Rockwell Corp., Anaheim, Calif.
STABILITY OF TWO-DIMENSIONAL POISEUILLE FLOW
J. R. Radbill and E. R. van Driest Sep. 1967 40 p refs
(Contract AF 49(638)-1442)
(C7-2239/020; AFOSR-67-2420; AD-661570)

The report is the second in a series in the exact numerical calculations of the stability of viscous flows by the method of quasilinearization. It describes results for the growth or decay of Tollmien-Schlichting type disturbances in a two-dimensional Poiseuille or channel flow. Results are presented for the second, third, and fourth modes of instability, as well as for the first (fundamental) mode. The computations were carried out by applying the quasilinearization method to the Orr-Sommerfeld equation. The minimum critical Reynolds number for the channel flow was determined to be 11500 (based on maximum channel speed and full channel width). The second mode of the disturbance was investigated in the neighborhood of the minimum critical Reynolds number of the first mode and found to have an amplification exponent of -0.057. The damping of the second mode was found to decrease with increasing Reynolds number, but its neutral curve was not located. The shapes of the eigenfunctions for the third and fourth modes were also determined. Author (TAB)

N68-13159# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF TRANSVERSE SURFACE CURVATURE IN THE CHARACTERISTICS OF A NONISOTHERMAL AXIALLY SYMMETRICAL TURBULENT BOUNDARY LAYER OF COMPRESSIBLE GAS [VLIYANIYE POPERECHNOY KRIVIZNY POVERKHNOSTI NA KHARAKTERISTIKI NEIZOTERMICHESKOGO OSESIMMETRICHNOGO TURBULENTNOGO POGRANICHNOGO SLOYA SZHIMAYEMOGO GAZA]
A. S. Ginevskiy and Ye. Ye. Solodkin 21 Feb. 1967 23 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR, Ser. Mekhan. i Mashinostr. (Moscow), no. 1, 1963 p 99–110
(FTD-HT-66-430; AD-661906)

Contents: Initial system of equations, boundary conditions; Temperature distribution in boundary layer; Velocity profile and resistance law; Integration of pulse equation; Determination of boundary layer characteristics; Effect of transverse surface curvature on the friction resistance coefficient at various Reynolds, Mach numbers and temperature factor; Comparison of calculation and experimentation data; Derivation of formulas for r^* and s. TAB

N68-13202# Hydronautics, Inc., Laurel, Md.
EFFECTS OF AMBIENT CONDITIONS, THE GRAVITY FIELD, AND STRUTS, ON FLOWS OVER VENTILATED HYDROFOILS
R. Altmann and C. Elata May 1967 64 p refs
(Contract N00014-66-C-0003)
(TR-605-1; AD-661862)

A series of experiments was conducted to determine the effects on foil performance of changes in cavity pressure and submergence depth. With fully-ventilated foils, drag and lift coefficients were found to be proportional to (1 + sigma sub cav), as predicted by theory. For base-ventilated foils a different and unexpected dependence of drag and lift on the cavity cavitation number was observed. Lift and drag on fully ventilated hydrofoils were also found to be almost unaffected by changes in submergence depth over the range of practical interest, as predicted by theory. However, the magnitudes of the measured forces were found to be smaller than predicted values. A simple analysis was made of the possible effects of the gravity field on foil performance. Further support for the idea that the gravity field may exert considerable influence was obtained through a series of tests in which ventilated hydrofoils were operated at both positive and negative angles of

attack. Measurements were also made to determine the effects of struts on ventilated hydrofoil cavity contours. Indirectly, these tests also assessed the magnitude of the strut-induced downwash. A considerable downwash was found to exist, having a profound effect on the cavity shape over the hydrofoil. Recent linearized theory on the magnitude of this strut-induced downwash correlates very well with the measurements. Author (TAB)

N68-13226# Aerospace Corp., El Segundo, Calif. Lab. Operations.
STAGNATION POINT BOUNDARY LAYER WITH LARGE WALL-TO-FREESTREAM ENTHALPY RATIO
Harold Mirels and William E. Welsh, Jr. Sep. 1967 38 p refs
(Contract F04695-67-C-0158)
(TR-0158(3240-10)-2; SAMSO-TR-67-38; AD-661581)

The effect of large surface-to-freestream enthalpy ratios on stagnation point shear and heat transfer is investigated for two-dimensional and axisymmetric bodies. Numerical solutions are obtained for a wide range of enthalpy ratios and wall transpiration rates. Absorption of externally imposed thermal radiation by the transpired gas is included for cases where the absorption is small compared to thermal conduction. It is found that the pressure gradient causes large velocity overshoot in the boundary layer. In the limit of infinite enthalpy ratio the peak velocity in the boundary layer is approximately 4/9 or 1/3 that value that would occur at the wall for an inviscid two-dimensional or axisymmetric flow, respectively, with the same temperature ratio. The application of the numerical results to cold flow plus radiation nose-tip test facilities is also noted. Author (TAB)

N68-13254# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
SOME RELATIVISTIC GENERALIZATIONS OF GAS DYNAMICS
Frederic E. Bisshopp Sep. 1967 29 p refs
(Contract Nonr-562(42))
(TR-5; AD-661205)

The thermodynamic notions which have been successful in the synthesis of classical gas dynamics can be generalized to apply in Minkowski space, possibly in more ways than one. A straightforward generalization of the first and second laws is used to suggest a number of relativistic generalizations of gas dynamics. The theories discussed are all covariant and they all reduce to classical gas dynamics asymptotically when the four-velocity approaches (1, 0, 0, 0) uniformly, but they differ in their description of second order effects. In the absence of definitive measurements of relativistic effects, it is suggested that the choice of a relativistic theory may be largely a matter of taste. Author (TAB)

N68-13256# Naval Ordnance Lab., White Oak, Md.
WIND TUNNEL SIMULATION OF HEAD-ON BOW WAVE-BLAST WAVE INTERACTIONS
David L. Merritt and P. M. Aronson 9 Aug. 1967 129 p refs
(NOLTR-67-123; AD-661790)

A unique wind tunnel - shocktube technique for simulating the head-on interaction between a supersonic vehicle and a blast wave is described. The technique is verified by comparing theory with pressure measurements from a wedge and a hemisphere. Overpressure data are presented for a slender cone at angles of attack up to 10 degrees. Author (TAB)

N68-13259 France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
DISCUSSION ON THE CRITERIA OF NEAR-EQUILIBRIUM [DISCUSSION SUR LES CRITERES DE PROCHE EQUILIBRE]
Roger Prud'homme 1967 65 p refs In FRENCH; ENGLISH summary
(ONERA-TN-115(1967))

In this technical note a comparative study of the criteria of near-equilibrium proposed by various authors is carried out. Firstly the criteria applicable to monoreactive flows are dealt with. The expressions proposed are studied in detail and they are compared by means of DMAKOHLER's first parameter. Then the criteria of multireactive flows are studied and compared. The equivalence of the various criteria in both cases is shown. Moreover, the notions of chemical time and of mechanical time are analyzed. It is shown, in particular, that several kinds of chemical times exist and a table containing their expressions are presented. The same has been done for mechanical times. Finally, a critical study of the criteria of sudden freezing is presented. This short study shows that such criteria should not be applied without a thorough examination. Author

N68-13274 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. Fuer Strahlantriebe.
THERMOGASDYNAMIC CHANGE OF STATE OF A GAS FLOW WITH VARIABLE MASS FLOW DENSITY UNDER HEAT ADDITION [THERMOGASDYNAMISCHE ZUSTAND-SAENDERUNG EINER GASSTROEMUNG MIT VERAENDERLICHER MENGENSTROMDICHTE BEI WAERMEZUFUHR]
P. Nitsch Jan. 1967 89 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-48)

A system of differential equations describing a one-dimensional steady gas flow with heat addition is given. It can be integrated by use of special assumptions. For the four most important special cases, equations for the variation of Mach number, velocity, cross section, and variables of state with heat addition and initial conditions have been obtained. Numerical results calculated for a gas with a ratio of specific heats of $\chi = 1.40$ are plotted in various diagrams. Preliminary studies on parts of this problem carried out in 1964 have now been verified. Author

N68-13291# Illinois Univ., Urbana. Coordinated Science Lab.
NUMERICAL STUDIES OF STRONG SHOCK WAVES. PART 10: ON THE ACCURACY OF MONTE CARLO SOLUTIONS OF THE NON-LINEAR BOLTZMANN EQUATION
Bruce L. Hicks and Margaret A. Smith Sep. 1967 36 p refs
(Contracts DAAB-07-67-C-0199; N0014-66-C-0010-A01)
(R-630, Pt. 10; AD-661338)

Nordsiecks Monte Carlo method of evaluating the Boltzmann collision integral made possible for the first time solutions of the non-linear Boltzmann equation for many kinetic theory problems of interest. The paper summarizes an extensive series of numerical calculations directed toward understanding and evaluating the various errors in these solutions. A generally useful method is described that permits estimation of the random or Monte Carlo part of the error in any quantity derivable from the computed values of the velocity distribution function or from the two parts of the Boltzmann collision integral. Some of the systematic errors can be evaluated. The errors in the velocity distribution function, in the collision integral and in moments of each of these function are discussed for two problems of physical interest for which the Boltzmann equation has been solved by the Monte Carlo method on the CDC 1604 computer, namely, for the pseudo-shock and the shock wave. In the solution of the shock problem for a Mach number of 2.5, the random errors in the velocity distribution function and the collision integral amount to 2% or less, and random errors in the moments of these functions range from 0.03 to 2.7%. Author (TAB)

N68-13297# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.

UNSTEADY BOUNDARY LAYER FLOW OVER AN OSCILLATING THIN FOIL

Wen-Hwa Chu 21 Jul. 1967 44 p refs

The unsteady potential flow at the edge of the boundary layer over a pitching and heaving foil was derived first. The harmonic components of the unsteady boundary layer were then calculated, based on an approximation analogous to an Oseen type equation, as an extension to the diffusion equation used for rapidly oscillating streams. The mean boundary layer flow with effective pressure gradient terms was subsequently calculated by the Karman–Pohlhausen method and numerical integration, and the point of instability was determined by the use of the universal stability curve. However, nowhere on the foil did the minimum wall shear vanish. A tentative explanation of the discrepancy between the theory and some experiments is given. Author

N68-13303# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

THE METHOD OF CHARACTERISTICS FOR THREE-DIMENSIONAL REAL-GAS FLOWS INCLUDING THE DIGITAL COMPUTER PROGRAM DETAILS AND OPERATING PROCEDURES FOR FROZEN FLOWS Final Report, 1 Apr. 1963–Nov. 1966

Charles R. Strom Wright-Patterson AFB, Ohio AF Flight Dyn. Lab. Jul. 1967 241 p refs

(Contract AF 33(657)-10423)

(CAL-AM-1800-Y-4; AFFDL-TR-67-47; AD-661342)

The method of characteristics is formulated for the computation of the supersonic flow of an inviscid, reacting gas over a smooth three-dimensional body. Various methods of constructing networks of bicharacteristic lines are examined from the point of view of numerical stability and accuracy. A new method of forming the network, which consists of projecting forward along streamlines from data points on specified data planes, is found to be most easily adopted to the particular requirements of nonequilibrium chemistry. The general method was coded for the IBM 7090 computer and the program demonstrated for the case of an ideal gas. Calculations were made for the case of an ideal gas. Calculations were made for the flow about a spherical-tip 15 degree half-angle cone at 10 degree angle of attack and a generalized elliptical body at zero incidence. Since the program yields the pressure distribution along specified streamlines, it is straightforward, in principle, to link it to a finite-rate chemistry stream tube program to treat three-dimensional, nonequilibrium flows. Author (TAB)

N68-13315# Naval Ship Research and Development Center, Washington, D. C. Hydromechanics Lab.

INFLUENCE OF SCALE RATIO, ASPECT RATIO, AND PLANFORM ON THE PERFORMANCE OF SUPERCAVITATING HYDROFOILS

Gabor F. Dobay Aug. 1967 90 p refs

(NSRDC-2390; AD-661866)

Seven hydrofoil models, having geometrically similar section shapes, were tested to evaluate the effect of scale, aspect ratio, and planform on the performance of supercavitating hydrofoils. No appreciable scale effect was found for scale ratios up to 3 in the fully-cavitating flow region. The experimental results indicate that the induced angle of attack, due to finite aspect ratio, reduces more rapidly in cavitating flow than is experienced in fully wetted flow as the aspect ratio increases. Also, the influence of the tip vortex on the effective aspect ratio is different for different flow regions. Judging from the overall behavior of these hydrofoils, two major conclusions can be drawn: (1) little improvement is achieved in the overall performance of the hydrofoil by increasing the aspect ratio above 3, and (2) moderate taper ratio seems to be advantageous in view of the overall performance of supercavitating hydrofoils. Author (TAB)

N68-13332 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EVOLUTION EQUATIONS OF RAREFIED GAS [EVOLYUTSIONNYYE URAVNENIYA RAZREZHENNOGO GAZA]

R. N. Miroshin *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 117–127 refs (See N68-13323 04-19)

This paper attempts to derive a relationship between the theory of a rarefied gas, developed on the basis of the integral equation of S. V. Vallander, and the theory of a purely discontinuous, random, Markov process, as studied by V. Feller and V. M. Dubrovskiy. The probability that an atom will be displaced from an initial point ($\bar{r}_0$, $\bar{u}_0$) in phase space to a region E at the instant t, is expressed by P(E, t $\bar{r}_0$, $\bar{u}_0$, t). The paper is then devoted to deriving equations for this probability and to showing how they are related to the integral equations mentioned above. Author

N68-13374* Oklahoma Univ., Norman. Graduate College.

FLOW INSTABILITY THRESHOLDS IN A NATURAL-CIRCULATION LOOP

Billy Jay Walker (Ph.D. Thesis) 1967 242 p refs Sponsored by NASA

(Grant NSF GK-742)

(NASA-CR-91500) CFSTI: $3.00 CSCL 20D

An analytical and experimental investigation was made of the flow instability threshold in a closed natural-circulation loop. The "density effect" model formulated by Boure was utilized to predict the instability threshold in terms of dimensionless parameters. Comparison with experimental data showed that the model which is based on large density changes as the sole driving mechanism for the oscillations was sufficiently accurate to predict pressure and flow instabilities. The various vibrational modes of the loop were calculated and compared with the experimental oscillations. Results showed that the loop tended to vibrate at frequencies comparable to the natural frequencies of the various modes of vibration of the loop. Author

N68-13493# Aerodynamische Versuchsanstalt, Gottingen (West Germany).

THE FLOW FIELD AROUND A SPHERE AT VERY LOW GAS-DENSITY (KNUDSEN-NUMBER KN→∞) [DAS STROEMUNGSFELD UM EINE KUGEL BEI SEHR GERINGER GASDICHTE (KNUDSEN-ZAHL KN → ∞)]

K. Kraemer Apr. 1967 51 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-33) CFSTI: HC $3.00/MF $0.65

Assuming a steady state, an infinite free path of the gas molecules and diffuse reflexion at a convex body surface, the distribution function of the molecules at any field point is given in the beginning. The (well known) boundary values of the fluid dynamic variables at the solid surface are derived from it. Then it is shown, that the mass-flow-density is the only field variable which is independent of the body temperature. Considering finally the special case of a sphere, 13 scalar field variables are expressed as twofold integrals, 4 of which are computed numerically. These are the distributions of the mass-density and the mass-flow-density at Mach numbers 0, 1, 1, 10 with both a cold and an adiabatically heated sphere. Author

N68-13812*# IIT Research Inst., Chicago, Ill.

MEASUREMENT OF TURBULENT CORRELATIONS IN A COAXIAL FLOW OF DISSIMILAR FLUIDS

Gerard J. D'Souza, Anthony Montealegre, and Herbert Weinstein Washington NASA Jan. 1968 60 p refs

(Grant NSG-694)

(NASA-CR-960) CFSTI: HC $3.00/MF $0.65 CSCL 20D

In this work axial turbulence intensities in a coaxial flow of dissimilar gases are presented. The system consisted of a circular freon 12 stream issuing into a faster and much larger air stream. The air–freon 12 density ratio is 1/4. The velocity ratios ranged from 40:1 to 5:1 with an absolute air velocity not exceeding 56.0 ft/sec. The magnitude of the axial turbulence intensities depends much on the velocity ratio of the streams. It is usually found to have a maximum value at some point between the centerline and the radius of the inner jet and then diminish to the free stream turbulence intensity. In the two cases of high air–freon velocity ratio a maximum turbulence intensity of 70% was obtained in the initial mixing region. Density fluctuations were also measured but these are shown to be damped by the measuring device. Values of the correlation between velocity and density fluctuations obtained are not valid and hence are not presented, as the damped density fluctuations affect this quantity considerably. A comparison is made between axial turbulence intensities for the heterogeneous case and those for the homogeneous case available in the literature. Author

N68-13619*# IIT Research Inst., Chicago, Ill.
ANALYTICAL INVESTIGATION OF THE MIXING OF TWO PARALLEL STREAMS OF DISSIMILAR FLUIDS
Richard L. Baker and Herbert Weinstein Washington NASA Jan. 1968 128 p refs
(Grant NsG-694)
(NASA-CR-956) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The free jet mixing of parallel streams of different fluids is of fundamental importance and interest. The degree of mixing depends on the regime of flow in the mixing region, i.e., laminar or turbulent, and the velocity and density ratios. In this work, similarity solutions were obtained for laminar and turbulent mixing of two parallel incompressible streams. The solutions apply to both similar and dissimilar fluids in the two streams with any velocity or density ratio and arbitrary laminar or turbulent Schmidt numbers. A solution is numerical in nature and a set of solutions are presented in tabular form for a spectrum of density, velocity and Schmidt numbers. Author

N68-13641# California Univ., Berkeley. College of Engineering.
INVISCID AND VISCOUS MODELS OF THE VORTEX BREAKDOWN PHENOMENON
Hartmut H. K. Bossel (Ph.D. Thesis) Aug. 1967 150 p refs
(Contract Nonr-222(79); Grant NSF-GK-1297)
(AS-67-14; AD-660672)

In the case of high swirl and large Reynolds number, the Navier-Stokes equations for rotationally symmetric incompressible flow are shown to reduce to (1) a viscous parabolic system for slender (quasicylindrical) flows and (2) an inviscid elliptic system for expanding (or contracting) flows. The inviscid system is solved for the case of flow with initial rigid rotation in a cylindrical stream surface. Assuming different downstream boundary conditions, Fourier-Bessel series solutions are computed for the supercritical (nonoscillatory) case and plotted. For very high swirl values, closed and open bubbles of recirculating fluid are obtained for certain cases, where the closed bubbles resemble those observed in vortex tube experiments. The viscous slender problem is formulated in an integral method, using approximating functions for axial velocity and circulation which satisfy boundary and asymptotic requirements. Weighting functions are used to generate a linearly independent set of equations of sufficient number to determine the coefficients in the velocity and circulation approximations as functions of one (the axial) coordinate. The formulation is for any order of approximation. Computational difficulties appear near the suspected breakdown point. Flows resembling breakdown flows are obtained. Author (TAB)

N68-13645 Wissenschaftliche Gesellschaft fur Luft- und Raumfahrt, Munich (West Germany).
GASDYNAMIC FUNCTIONS AND THEIR APPLICATIONS (SYNOPSIS OF FORMULAE AND TABLES INCLUDED) [GASDYNAMISHE FUNKTIONEN UND DEREN ANWENDUNGEN MIT FORMELSAMMLUNG UND TABELLENTEIL]
B. v. Schlippe Dec. 1966 188 p In GERMAN, ENGLISH summary
(DLR-FB-66-82) CFSTI: $3.00

For the solution of problems of gas-dynamics, particularly the one-dimensional flow, a method is given by means of which the calculations are essentially simplified. For this purpose, so-called gas-dynamic functions (GDF) are introduced, which are compiled in tables for several x-values of gases in part II of this paper. In part I, the introduced relations are derived and several examples of frequently arising problems of gas dynamics are discussed. Author

N68-13759# General Electric Co., Philadelphia, Pa. Missile and Space Div.
ON UPSTREAM INFLUENCE IN VISCOUS INTERACTION PROBLEMS
Richard W. Garvine Dec. 1967 36 p refs
(R67SD41)

A study of hypersonic viscous interaction on a flat plate is presented. The viscous–inviscid equations, which permit the existence of transverse pressure gradients in viscous layers are integrated numerically. It is shown that these solutions develop singular behavior with respect to the initial data employed, such as streamwise velocity and density profiles. The origin of this singular dependence is then investigated by means of a linearized viscous interaction model. It is found that such an interaction problem is improperly set as an initial value problem, because a term enters the governing equation through the interaction dynamics that contain upstream influence. Finally, an approximate numerical method is presented to develop the nonsingular solution for the system of coupled nonlinear equations. Author

N68-13808# Catholic Univ. of America, Washington, D. C. Dept. of Mechanical Engineering.
WALL TEMPERATURE EFFECTS ON SUBSONIC GAS FLOWS Final Report
William J. Kelnhofer 1 Oct. 1967 88 p refs Prepared in cooperation with Aerodynamische Versuchsanstalt Gottingen, *Its* Rept. No. 67-A-26
(Contract Nonr-0014-67-C-0149)
(AD-661335)

A theoretical study is made for calculating various boundary layer thicknesses at a point on a heated or cooled wall assuming n-power velocity and m-power temperature profiles in subsonic gas flow. Also, boundary layer measurements are made for air flowing over a flat plate heated to 250C with velocities up to 30 m/s. The experimental results are compared to previous theoretical results assuming n = m and the velocity and thermal boundary layer thicknesses equal in fully developed flow. Author (TAB)

N68-13811 Atomic Weapons Research Establishment, Aldermaston (England).
COMPUTER STUDIES OF SHOCK INITIATION IN HOMOGENEOUS AND HETEROGENEOUS EXPLOSIVES
I. C. Skidmore [1967] 6 p refs Presented at the High-Dyn. Pressure Symp., Paris 11–15 Sep. 1967

A Lagrangian mesh code has been used to compute the initiation behaviour of liquid and solid explosives decomposing

respectively according to an Arrhenius rate law or an empirical shock pressure sensitive law, when subjected to different shock profile inputs. The computed induction times for liquid explosives may be interpreted by a simple extension of the adiabatic explosion time concept. In solid explosives the computations are sensitive to mesh size but parameters may be chosen to give results in good agreement with experimental data for sustained shock initiation. Author

N68-13845 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LONGITUDINAL ACOUSTIC VIBRATIONS IN A TUBE OF VARIABLE SECTION [PRODOL'NYYE AKUSTICHESKIYE KOLEBANIYA V TRUBE PEREMENNOGO SECHENIYA]
V. I. Prokop'yev *In its* News of Schools of Higher Educ. Aeron. Ener. 21 Mar. 1967 p 34–41 refs (See N68-13841 04-28)

Equations are formulated to solve the problem of determining the natural frequencies of the longitudinal acoustic vibrations of a stationary gas column in a tube having axial symmetry, variable section, and a rigid envelope. It is assumed that the parameters of the medium are identical in a plane perpendicular to the tube axis. A solution is also proposed to the problem of the natural frequencies of longitudinal sound vibrations of the gas column inside a perfectly rigid circular–conical shell that is closed at both ends. Author

N68-13873# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
FORMATION AND CATCHING OF A GAS HYDROGEN JET IN VACUUM [FORMIROVANIE I ULAVLIVANIE GAZOVOI VODORODNOI STRUT V VAKUMME]
L. S. Zolin, V. A. Nikitin, and Yu. K. Pilipenko 1967 20 p refs In RUSSIAN
(JINR-P13-3425)

An experimental system for the formation and catching of a gas hydrogen jet in vacuum is described. The diameter of the obtained jet is about 2 cm and the density–10^{-7} g/cm^2. The jet is well caught by a helium condensation pump. The problem is solved of creation of a gas hydrogen target to operate with the internal beam of an accelerator. Author (NSA)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-12808# Naval Oceanographic Office, Washington, D. C.
MANUAL OF SIMPLE FIELD TECHNIQUES FOR MEASURING WATER LEVEL FLUCTUATIONS AND SURFACE CURRENT PATTERNS
Willis S. Glidden and Donald A. Burns 23 Jun. 1967 33 p refs
(NOO-IR-67-50; AD-655246)

The manual is designed to provide the non-professional hydrographer with the necessary techniques for taking water level and current measurements in rivers and canals. Those techniques which negate the need for sophisticated field equipment are stressed. Examples of data recording forms and instructions are provided to aid in collecting field observations. Author (TAB)

N68-12817 Wisconsin Univ., Madison. Meteorology Dept.
STUDIES IN ATMOSPHERIC ENERGETICS BASED ON AEROSPACE PROBINGS Annual Report, 1966
Mar. 1967 135 p refs
(Grant CWB-WBG-27)

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7. THE PROTOTYPE FLAT-PLATE RADIOMETERS FOR THE ESSA III SATELLITE D. F. Nelson and R. Parent p 119–129 (See N68-12824 04-14)

N68-12819 Wisconsin Univ., Madison.
THE REFLECTION OF SUNLIGHT TO SPACE AND ABSORPTION BY THE EARTH AND ATMOSPHERE OVER THE UNITED STATES DURING SPRING, 1962
Kirby J. Hanson, Thomas H. Vonder Haar, and Verner E. Suomi *In its* Studies in Atmospheric Energetics based on Aerospace Probings Mar. 1967 p 41–58 refs (See N68-12817 04-13)

Low resolution radiometric data from TIROS 4 are combined with surface radiation measurements to determine the reflectance and absorption of sunlight. The values of solar irradiance incident and reflected from the top of the atmosphere and from the earth's surface are used to mathematically define the absorption in the atmosphere. An equation is formulated to show that the sunlight incident at the top of the atmosphere is divided between two absorption terms—the absorption in the atmosphere, and the absorption at the earth's surface—and one reflection term—the reflection of sunlight to space by the earth, atmosphere, and clouds. Results of the calculations indicate that for the United States during the spring of 1962, 40% of the incident sunlight at the top of the atmosphere was reflected to space. 13% was absorbed by the atmosphere and clouds, and 47% was absorbed at the earth's surface. Atmospheric absorption of sunlight varied from over 20% in the moist air in the southeastern part to less than 10% over much of the dry mountainous west, and the northern plains. M.G.J.

N68-12820 Wisconsin Univ., Madison.
ALBEDO OF A STRIATED MEDIUM OF ISOTROPICALLY SCATTERING PARTICLES
James A. Weinman and P. N. Swarztrauber *In its* Studies in Atmospheric Energetics Based on Aerospace Probings Mar. 1967 p 59–78 refs (See N68-12817 04-13)

Giovanelli's approximation to the equation of radiative transfer was solved to yield the albedo of an externally illuminated plane-parallel striated medium. The medium was assumed to consist of isotropic scatterers with a scattering coefficient per unit

depth: $K = K_0 + K_1 \cos(\beta x)$ that oscillated periodically on one horizontal coordinate. The albedo computed for $K_1/K_0 = 0$, 0.1 and 0.9 demonstrated a dependence on the angle of incidence of the solar radiance, the mean optical thickness, and the wave length and amplitude of the striations. Author

N68-12875# Massachusetts Inst. of Tech., Cambridge. Geophysics Lab.

ELECTROMAGNETIC EFFECTS OF ATMOSPHERIC GRAVITY WAVES Interim Technical Report

Jon F. Claerbout (Ph.D. Thesis) 12 May 1967 177 p refs

(Contract DA-31-124-ARO(D)-431)

(AROD-6086.1-EN; AD-661650)

Continuous observations of pressure fluctuations at gravity wave periods (5-30 minutes) in eastern Massachusetts show that the only important pressure fluctuations not associated with moving weather sources are fluctuations associated with the jet stream. These fluctuations appear to be non-dispersive and move a little slower than the maximum overhead jet stream velocity. The coupling between gravity wave modes and fluctuations in the jet stream is examined to investigate the pumping of energy from the jet stream into the upper atmosphere. The energy flux emitted from the critical altitude where the velocity of the disturbance matches the velocity of the mean wind is amplified by the wind shear as the wave moves away from the critical height. A wave packet moving into a critical zone becomes so compressed before it reaches the critical altitude that the wind shear within the wave itself causes the atmosphere to become locally unstable. Typical energy propagation to the ionosphere D-region (80 km.) takes 10 hours where amplitudes will be 10 meters/second. The waves are strongly reflected by temperature gradients in the lower thermosphere. Author (TAB)

N68-12924# Naval Weapons Lab., Dahlgren, Va.

A RELATION BETWEEN SYSTEM VARIABLES RESULTING FROM PHYSICAL DIMENSIONS

Charles J. Cohen 10 Nov. 1967 16 p

(NWL-2122; AD-661482)

A non-trivial relation between system parameters and system observables is developed which is based only on dimensional analysis. It finds application in the BLP test. This test is used to partially validate the numerical elements in least squares equations for geodetic parameters when the observables are Doppler data from earth satellites. Author (TAB)

N68-12938# Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

SURFACE ENERGY BALANCE OF BARE SOIL AS INFLUENCED BY WETTING AND DRYING Interim Report

C. H. M van Bavel Ft. Huachuca, Ariz. Army Electron. Proving Ground Jun. 1967 74 p refs

Cross Service Order-2-67)

(ECOM-2-67P-2; RR-397; RCS-OSD-1366; AD-657634)

A bare soil surface of Adelanto clay loam was allowed to dry superficially and then flooded with 11 cm of water. Physical events over, at and below the surface were recorded continuously throughout eight days, beginning with the day before flooding. The terminal condition was close to the original one. The experiment took place in April-May 1966 in Phoenix, Arizona during a period of stable, clear and dry weather. When the surface was dry, net radiation and soil heat flow were the principal energy transfer processes. When the soil surface was wet, net radiation and latent heat transfer predominated, but soil heat flow was still more important than sensible heat transfer in the air. The last quantity did not change much in size or magnitude as result of flooding and remained negative during the daylight period. A surprising result was obtained for the period during which the surface first became dry, firm and lighter in color. Though net radiation was decreased, evaporation continued at the potential rate and large, positive values of sensible heat flux in the air were measured. These values did not agree with the measured differences between surface and air temperature, but it was also noted that any aerodynamic method, used to calculate the sensible heat flow in the air from surface temperatures, failed utterly. Excellent predictions of the latent heat flux during wet surface conditions were obtained with the Dalton-log law model and also with the combination model. Less accurate, but still acceptable prediction followed from the Bowen ratio method. Author (TAB)

N68-12945* Southwest Center for Advanced Studies, Dallas, Tex.

INFLUENCE OF PARTICLE SIZE DISTRIBUTION ON REFLECTED AND TRANSMITTED LIGHT FROM CLOUDS

George W. Kattawar and Gilbert N. Plass 24 Aug. 1967 41 p refs Supported in part by NASA

(Contract AF 19(628)-5039)

(NASA-CR-91301; SR-5; AFCRL-67-0428; AD-660604) CSCL 04A

The light reflected and transmitted from clouds with various drop size distributions is calculated by a Monte Carlo technique. Six different models are used for the drop size distribution: isotropic; Rayleigh; haze continental; haze maritime; cumulus; nimbostratus. The scattering function for each model is calculated from the Mie theory. In general the reflected and transmitted radiance for the isotropic and Rayleigh models tend to be similar as are those for the various haze and cloud models. The reflected radiance is less for the haze and cloud models than for the isotropic and Rayleigh models, except for an angle of incidence near the horizon when it is larger around the incident beam direction. The transmitted radiance is always much larger for the haze and cloud models near the incident direction; at distant angles it is less for small and moderate optical thicknesses and greater for large optical thicknesses (all comparisons to isotropic and Rayleigh models). The downward flux, cloud albedo, and mean optical path are discussed. The angular spread of the beam as a function of optical thickness is shown for the nimbostratus model. Author (TAB)

N68-12982# Geoscience, Inc., Cambridge, Mass.

PROGRAMS FOR THE ANALYSIS OF MAGNETO-TELLURIC DATA. PART 1: THEORY

Benjamin J. Woznick Apr. 1967 42 p refs

(Contract Nonr-4900(00))

(RU-67001; AD-661843)

A package of programs for the editing and analysis of magneto-telluric data has been developed. The editing program (DGEDT 1) is designed to correct for all detectable errors due to digitizer malfunction. A tape merge program (DGMRG1) has been prepared to permit the economical storage of edited data. A short discussion and listings of these programs appear in Part II of this report. An analysis program (MTANAL) which permits the computation of apparent resistivities as a function of frequency has been prepared. The theory of this analysis is presented. TAB

N68-12987 National Physical Lab., New Delhi (India). Radio Propagation Unit.

IONOSPHERIC DATA

Aug. 1966 82 p Prepared for Radio Res. Comm., Council of Sci. and Ind. Res., New Delhi

(RRC-A135, Pt. 1)

Tabulated ionospheric data are presented for the following stations in India: Delhi, Ahmedabad, Haringhata, Bombay, Hyderabad, Madras, Tiruchirapalli, Kodaikanal, and Thumba. N.E.N.

N68-13073# Aerospace Corp., El Segundo, Calif. Lab. Operations.
LATITUDE DISTRIBUTION OF THE DAYTIME OZONE PROFILE ABOVE THE PEAK
D. D. Elliott, M. A. Clark, and R. D. Hudson Sep. 1967 18 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-10)-2; SAMSO-TR-67-39; AD-661600)

The earths daytime radiance has been measured from 1700 to 3200A with 6A resolution. The spectrum, taken with an Ebert-Fastie monochromator on board a polar-orbiting satellite, was scanned every 1.5 deg of latitude as the satellite passed along a meridian from 60 deg N to 90 deg S. Using the Green-Twomey theory, we have analyzed the spectra to yield the latitude dependence of the value of the ozone scale height at about 50 km altitude. For local time 1230 hours on December 15, 1966, this scale height was symmetric about the equator with a shallow 10 minimum at the equator, and had a value of 3.8 km at the northern mid-latitudes. Author (TAB)

N68-13083# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
RESEARCH IN GEODETIC GRAVIMETRY AND THEORY OF THE EARTH'S FIGURE [ISSLEDOVANIYA PO GEODEZICHESKOY GRAVIMETRII I TEORII FIGURY ZEMLI]
Nov. 1967 166 p refs Transl. into ENGLISH from Tr. Tsentr. Nauchn.-Issled. Inst. Geodezii, Aeros'yemki Kartografii (Moscow), issue 171 p 1-92
(ACIC-TC-1282; AD-661810)

Contents: Some problems connected with the treatment of spatial networks; A method for expanding the gravity potential of the earth in spherical functions; The effect of the earths ellipticity on its stokes constants; Evaluation of a correction term of stokes approximation to stokes constants from the data for the caucasus and Central Asia; Differential formulas for distance, astronomic and geodetic azimuths and zenith distances as checked on particular example; The effect of the inner zone on the topographical correction to gravity. TAB

N68-13097# Stanford Univ., Calif. Radioscience Lab.
ARECIBO EVALUATION PANEL Final Report, 15 Aug. 1962-14 Aug. 1967
R. N. Bracewell Oct. 1967 15 p refs
(Contract AF 49(638)-1181)
(SEL-67-089; AFOSR-67-2173; AD-661348)

The activity of the Arecibo Evaluation Panel during the five years from 15 August 1962 to 14 August 1967 is briefly summarized. The Panel was formed at the request of the Advanced Research Projects Agency to assist in evaluating plans and programs for research in ionospheric physics, and in radar and radio astronomy conducted by Cornell University at the Arecibo Ionospheric Observatory in Puerto Rico. This Observatory is supported by the Advanced Research Projects Agency and monitored by the Air Force Office of Scientific Research. The Panel has met about twice a year. The dates and places of the meetings are listed. The names and addresses of the members are given. An historical summary and description of the Arecibo Ionospheric Observatory is appended. Author (TAB)

N68-13133# Aerospace Corp., El Segundo, Calif.
SOME CONSEQUENCES OF HYDROMAGNETIC TURBULENCE THEORY ON PARTICLES AND FIELDS PHENOMENA IN THE MAGNETOSPHERE
Y. T. Chiu Oct. 1967 32 p refs
(Contract F04695-67-C-0158)
TR-0158(3260-20)-3; SAMSO-TR-67-73; AD-661962)

Model-independent consequences of the hypothesis that portions of the magnetosphere behind the bow shock are in a state of continual homogeneous turbulence are discussed. It is shown that such a hypothesis leads to a law governing the power spectra of magnetosheath and magnetosphere main phase fluctuations, and this is in agreement with experiment. The long life of main phase fluctuations is shown to follow from a theorem on the permanence of the largest eddies. Consideration is given to the theory that islands of energetic electron fluxes may be caused by electron acceleration by low-frequency, small-amplitude magnetosonic waves in a turbulent environment. Finally, the dominance of 30 to 40-minute fluctuations in the magnetosheath, geomagnetic storm main phase, the shock front, and the magnetophase emphasizes the importance of experimental cross-correlation study of particles and fields phenomena. Author (TAB)

N68-13146* Geological Survey, Flagstaff, Ariz.
EARTH RESOURCES SURVEY PROGRAM. RADAR IMAGES: SAN FRANCISCO VOLCANIC FIELD, ARIZONA: A PRELIMINARY EVALUATION
Gerald G. Schaber Aug. 1967 20 p refs
(NASA Order R-09-020-015)
(NASA-CR-91439; NASA-TL-84) CFSTI: $3.00 CSCL 08B

The airborne radar image system used employed a high frequency (K-band) side-looking radar with a multipolarization capability and recorded polarized and depolarized images simultaneously on each strip. Distortion is reported in the form of signal ripples parallel to the direction of flight of the aircraft. Cultural features except secondary roads showed moderately well to well, and topographic features were distinct. The depolarized image showed less tonal contrast but resolved the vegetation boundaries and defoliated better in dense pine areas than the polarized image. The geologic implications are discussed, and it is felt that the most useful attributes are the topographic enhancement capability and the ability to differentiate moisture retention units of soil and bedrock. N.E.N

N68-13177 Ionosphären-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, OCTOBER 1967 [IONOSPHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: FREIBURG, URSI-CODE 131, OKTOBER 1967]
Oct. 1967 45 p in GERMAN and ENGLISH
(Rept.-256-F)

Tabulated data on the vertical echo sounding are presented for October 1967. N.E.N.

N68-13178 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE NO. 171
5 Jan. 1968 135 p refs Transl. into ENGLISH from Russian
(JPRS-43878)

Abstracts, summaries, and occasional full translations are provided on Sino-Soviet bloc publications in the fields of astronomy, meteorology, oceanography, geophysics, and upper atmosphere and space research. Each area is broken down into the two general headings of news and abstracts of scientific articles. Complete bibliographic data accompanies each article. E.J.S.

N68-13267# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.

COMPUTATION OF GRAVITY CORRECTIONS FOR THE TERRAIN RELIFE WITH THE AID OF ELECTRONIC DIGITAL COMPUTERS [VYCHISLENIYE POPRAVOK SILY TYAZHESTI ZA REL'YEF MESTNOSTI S POMOSHCH'YU ETSVM]

V. V. Lomtadze Aug. 1967 5 p refs Transl. into ENGLISH from Neftegazovaya Geol.; Geofiz. (Moscow), no. 8, 1966 p 43–45
(ACIC-TC-1294; TT-67-62921; AD-658713)

A method for the computation of topographic corrections with the aid of an electronic digital computer is discussed in this translation. This system is characterized by the direct computation of the corrections for the points of observation Mk, whose coordinates Xk, Yk, Hk are fed into the computer, and by the elimination from the computations of the interpolation of the corrections and elevations. Integral can be computed numerically only. For computer calculations, the relief of the terrain is generally given in a tabular form with a square network. The described method assumes that the relief is in the form of the so-called numerical terrain model. For each section of the terrain corresponding to a square of the numerical model, the mean value of the elevation above sea level is determined and recorded. Author (TAB)

N68-13279*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

VERTICAL MOTIONS IN THE UPPER ATMOSPHERE DEDUCED FROM ROCKET MEASURED TEMPERATURES

C. Prabhakara and Joseph S. Hogan (New York Univ.) Dec. 1967 28 p refs Work conducted in part by New York Univ.
(Grant NsG-499)
(NASA-TM-X-60767) CSFTI: HC $3.00/MF $0.65 CSCL 04A

Rocket observations at high latitudes indicate a significantly cold thermal structure during summer in the upper mesosphere and lower thermosphere. From detailed considerations of radiative transfer we have obtained the infrared heating rates in this region of the atmosphere and deduced vertical velocities from these heating rates. We find that strong infrared flux convergence in the vicinity of 85 km results in a heating of about 10°K/day and positive vertical velocities of about 5 cm/sec. Such vertical velocities favor the formation of noctilucent clouds at this altitude. Author

N68-13342 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE QUESTION OF DETERMINATION OF MAXIMUM WIND VELOCITY IN A GIVEN INTERVAL OF TIME [K VOPROSU OPREDELENIYA MAKSIMUMA SKOROSTI VETRA V DANNOM INTERVALE VREMENI]

F. A. Dmitriyeva *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 213–215 refs (See N68-13323 04-19)

A new formula recently given by H. Cramer in the theory of normal stationary stochastic processes is applied to predict the behavior of the maximum wind velocity in a given time interval at a height of 32 meters above sea level. Observations agree satisfactorily with the predictions. Author

N68-13343 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF TIDAL DEVIATION OF A PLUMB LINE FROM THE VERTICAL IN THE ASTRONOMICAL DETERMINATION OF TIME [OB UCHETE PRILIVNOGO KOLEBANIYA OTNESNOY LINII PRI ASTRONOMICHESKOM OPREDELENII VREMENI]

V. S. Gubanov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 217–221 refs (See N68-13323 04-19)

Theoretically, the problem of the effect of tides on the vertical has been worked out with sufficient accuracy. However, this effect has not been taken into account in practical calculations, due to its low value. At present, due to the greater accuracy of astronomical observations, this error has become more important. The paper includes tables convenient for practical use, which were compiled on the basis of known formulas. Even though the computed figures are at the limit of accuracy for the astronomical determination of time, they will certainly be used in the future for highly accurate investigations. Author

N68-13371*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE PLASMAPAUSE AND ITS RELATION TO THE ION COMPOSITION IN THE TOPSIDE IONOSPHERE

H. G. Mayr Nov. 1967 22 p refs
(NASA-TM-X-63083; X-621-67-570) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The high O^+–H^+ transition level at latitudes above 50 degrees and the plasmapause with its characteristic density plateau suggest that both features are strongly correlated: upward fluxes of protons can consistently account for both observations. It is shown that plasma escape can produce sufficiently large fluxes at latitudes where the field lines are open, thus significantly decreasing the hydrogen-ion density. As a result, plasma diffusion across field lines is induced-coupled with upward fluxes of ionization along field lines, which leads to the formation of a density plateau that characterizes the transition region from the open to the closed magnetosphere. Collision-type perpendicular diffusion would produce an enormously rapid transition over a distance of a few meters, which is not observed. This suggests that a turbulent state is built up in the transition region; thus, Bohm's coefficient for turbulent diffusion is employed, and this leads to a quantitatively satisfying description of the plasma-pause. Author

N68-13390# Naval Scientific and Technical Intelligence Center, Washington, D. C. Translation Branch.

SOVIET EXPLORATIONS IN THE ANTARCTIC OVER THE 10 YEAR PERIOD (1956–1966) [SOVETSKIYE ISSLEDOVANIYA V ANTARKTIKE ZA 10 LET (1956–1966)]

E. S. Korotkevich 9 Oct. 1967 20 p Transl. into ENGLISH from Info. Bull. of the Soviet Antarctic Expedition (USSR), no. 57, 1966 p 5–20
(NIC-TRANS-2464; AD-661770)

During the ten year period of operations of the Soviet Antarctic Expedition it collected a vast volume of data pertaining to the nature of Antarctica and its surrounding waters. A broad complex of scientific studies is being carried out (various subdivisions of geophysics, cartography, physical geography, aero meteorology, oceanography, glaciology, geology, biology and medicine). In addition to stationary observations performed in different years at 10 basic and a number of mobile stations, observations were carried out during trips in Eastern Antarctica and on the Southern Ocean. As a result of this work enormous areas of ocean and land, previously nothing but blank spaces on the map, were subjected to a broad scientific scrutiny. Now the nature of the region is generally fairly well known. A number of monographs have been compiled, to cover the various elements. An Atlas of Antarctica has been created - a voluminous complex composition which characterizes Antarctica as a whole, as well as some of its specific areas. TAB

N68-13412*# Stanford Univ., Calif. Remote Sensing Lab.
FIELD INFRARED ANALYSIS OF TERRAIN Annual Report, 1 Nov. 1966–31 Oct. 1967
10 Dec. 1967 44 p refs
(Grant NGR-05-020-115)
(NASA-CR-91486; AR-2) CFSTI: HC $3.00/MF $0.65 CSCL 08G

The relationship of ground truth measurements to the infrared analysis of the terrain is outlined. The status, changes, and updatings of computer programs connected with the project are presented. CORRCO 360 replaced INTERIM 360 and NSCP programs. The TRIFID tape format description is given. Results of computer programs used for calculations in several meteorological problems are presented. The status of laboratory and field recording equipment (digital recording system, SG-4 spectrometer, CVF spectrometer, IT3 radiometer, and Mark IX radiometer) is described. Cost information concerning the total program effort is given. L.S.

N68-13439# Cornell Univ., Ithaca, N. Y. Engineering Physics Dept.
ABUNDANCE AND DISTRIBUTION OF CHLORINE IN IRON METEORITES
E. Berkey and D. E. Fisher 3 Feb. 1967 48 p refs Presented at the Intern. Assoc. of Geochem. and Cosmochem. Symp. on the Origin and Distribution of the Elem., Paris, 6–10 May 1967
(Contract AT(40-1)-3585)
(NYO-2794-14; CURL-17; CONF-670524-2) CFSTI: HC $3.00/MF $0.65

The abundance and distribution of chlorine in iron meteorites has been studied by neutron activation analysis and metallographic observation. It was found that the chlorine content of finds can be profoundly influenced by the effects of terrestrial weathering, being enhanced in some meteorites by many orders of magnitude over certain localized regions. The pathways used in the contamination process appear to be cleavages, grain boundaries, Neumann lines, and even direct passage through the metal matrix. Measurements of primordial (non-terrestrial) chlorine in the meterorites show that is inhomogeneously distributed in the metal phase. The element is strongly depleted in kamacite and tends to concentrate at grain boundaries and around inclusions. It is difficult to calculate an average value for the primordial chlorine content of irons on the basis of the data obtained, but indications are that a representative value is much lower than previous data which were not sufficiently cognizant of contamination effects. Author (NSA)

N68-13514# Harvard Univ., Cambridge, Mass. Dept. of City and Regional Planning.
DETERMINATION OF GEODESIC AND MINIMUM PATH LINES BY GRAPHICAL METHODS
C. Ernesto S. Lindgren 15 Nov. 1967 37 p refs
(Contract N00014-67-A-0298)
(TR-6; AD-661842)

The present study proposes a graphical method for the determination of a geodesic line between two points of a surface. A preliminary review is presented on plane curves and space curves with a discussion of the determination of the curvature, osculating circle, tangent lines, tangent planes. Since these curves are graphic (not mathematically equated) a graphical method is introduced. For space curves, the determination of the tangent, normal, and osculating planes is made by the descriptive method. All constructions thus presented can be expressed analytically. Therefore, it is feasible to digitize the geometric elements involved in those constructions and to write a program for their performance with a computer. The necessity of this becomes very obvious owing to the numerous, however simple, geometric constructions required in the determination of points of the geodesic line. Author (TAB)

N68-13589# Atomic Energy Commission Research Establishment, Riso (Denmark).
RECENT SPECTRA OF ATMOSPHERIC TURBULENCE
Niels E. Busch and Hans A. Panofsky (Pa. State Univ.) *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 215–257 refs *Its* Contrib. No. 66-119 (See N68-13581 04-31)

Spectra of atmospheric turbulence recently measured at various heights and sites under a variety of stability conditions were analyzed and compared in an effort to determine to what extent similarity theory is applicable to the vertical spectra. Results indicate that: (1) Vertical-velocity spectra below 50 m obey similarity theory well (the normalized spectra varying only with z/L, but not with height or terrain), with a possible anomaly over water; and above 50 m, the spectra shift toward larger f=nz/V. (2) Longitudinal spectra do no obey similarity theory at low frequencies, a fact which also influences the behavior of the maximum of the spectra. S.C.W.

N68-13590# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
WIND VARIABILITY IN TIME AND SPACE
Manuel Armendariz and Virgil D. Lang *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 259–284 refs (See N68-13581 04-31)

Wind data gathered from three windmill-type anemometers arranged in a triangular array are compared for varying lag times and sample averaging intervals. The anemometers were placed 274 meters apart at the vertices of an equilateral triangle at a height of 19 meters, thus yielding time and space variability of wind in range and cross sense simultaneously. Included are the root mean square errors (RMSE) of direction and speed differences, tabulated values of the coefficients and exponents of an exponential equation fitted to the variability curves, and the spectrum and cross spectrum of the wind components. Author

N68-13591# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
WIND PROFILES AND SHEAR DERIVED FROM SMOKE TRAILS
Manuel Armendariz, Laurence J. Rider, and Gerald C. Gill (Mich. Univ.) *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 285–296 refs (See N68-13581 04-31)

Simultaneous smoke trails from rockets launched 900 feet apart are examined for space and time variability and shear. The maximum height of the profile was 3000 feet and the minimum approximately 600 feet. Spacewise results obtained indicate that wind speed differences are generally less than 2.0 ft sec^{-1} and direction differences less than 5.0 degrees, except that under light wind conditions the direction differences were much larger. Timewise, wind variability was generally less than 2.0 ft sec^{-1} and 5.0 degrees for time lags up to 36 seconds. Wind shear calculated from these profiles substantiates the exponential relationship between the shear and layer thickness previously found at White Sands Missile Range and Cape Kennedy. The value of the exponent, 0.57 for the mean shear and 0.35 for the mean maximum shear, agrees with previous findings. Author

N68-13592# Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
WIND SPEED STATISTICS ALONG A HYPOTHETICAL MISSILE TRAJECTORY DOWNWIND OF A SINUSOIDAL MODEL HILL
Erich J. Plate, Paul Baer (Ballistic Res. Labs.), and F. F. Yeh *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 297–332 refs (See N68-13581 04-31)

The wind field is investigated which is encountered by a missile traveling along a hypothetical trajectory downwind of a two-dimensional hill. Reasons are given for studying this situation in a wind tunnel. The problem is reduced to the determination of turbulence spectra and of joint probabilities for the joint occurrence of two velocities simultaneously along the trajectory set by mean flow condition. Experimental studies are concerned with measurements of profiles of mean velocities and turbulent intensities and with the determination of turbulence data for evaluating spectra and joint probability distributions. The information contained in the turbulence spectra is discussed. An example of a joint probability determination is given and some preliminary conclusions are drawn. Author

N68-13593# New Mexico State Univ., University Park.
LOW LEVEL WIND STUDY
M. D. Freeman *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 333–355 ref (See N68-13581 04-31)

Tests were conducted to determine the reliability of the AN/MMQ-1B wind measuring set when used to measure incident wind and to determine the best method for predicting low level wind at time of fire. The hand-held anemometer ML-433 was also tested to determine the feasibility of using it as a back-up device for the AN/MMQ-1B wind measuring set. Two methods for applying the low level wind corrections were developed. The recurring method requires that the rocket firing wait until the previously measured wind recurs within ±1 mph per component. The predicted method uses a five minute average of the wind to predict the wind at a predetermined time of fire. Results of a comparative study of a five minute average with 1-1/2 minute average of wind are given. Among the conclusions drawn form these studies are: 1. Deviation of predicted wind from standard wind was large in both the 5 and 1-1/2 minute average interval, but there was no significant difference between the two intervals. 2. Actual time of fire can vary ±1/2 minute from desired time of fire without seriously affecting the reliability of the low level corrections made to the launcher. 3. Use of the ML-433 anemometer, in conjunction with the AN/MMQ-1B wind measuring set, to determine the value of predicted wind at T=0 (rocket firing time) can increase the reliability of this value, and hence, any launcher corrections made. S.C.W.

N68-13594# New Mexico State Univ., University Park.
THE NONDIMENSIONAL WIND SHEAR OVER HETEROGENEOUS TERRAIN
E. Peterson and H. A. Panofsky *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 357–360 (See N68-13581 04-31)

Presented is a discussion of existing theories concerning nondimensional wind shear over heterogeneous terrain, and inherent problems associated with the statistical determination of nondimensional wind shear in stable air and unstable air. S.C.W.

N68-13595# Atlantic Research Corp., Costa Mesa, Calif. Missile Systems Div.
A METHOD TO COMPUTE THE EFFECTS OF WIND ON THE DISPERSION OF A VERTICALLY LAUNCHED ROCKET
Robert L. Ammons and Charles P. Hoult (AFCRL) *In* N. Mex. State Univ. Unguided Ballistics Meteorol. Conf. 1967 p 381–390 refs (See N68-13581 04-31)

Described is a method for determining a standard deviation in ballistic wind which can be used in the analysis of the impact point dispersion of vertically launched rockets. It is assumed that errors in the rocket response model and errors due to wind measurements not being made along the rocket flight path do not contribute significantly to dispersion. Random errors in wind measurements and the effect of a time delay between wind measurement and flight are considered important. The approach used is to calculate the variance in ballistic wind. The result requires that the inter level wind error covariance matrix be known. When this, the weighting factor, and the unit wind effects are known, a rational estimate of wind effect on dispersion may be made. The wind error functions for Fort Churchill, Green River and White Sands have been computed from actual firing day meteorology, multiplied by a typical wind weighting factor form. The data thus reflect the measurement errors, time delays, and meteorology actually encountered in service. These data have been examined for their distribution. It is shown that the ballistic wind errors are approximately normally distributed. As is already well known, this leads to a nongaussian distribution for the impact points. Author

N68-13596# New Mexico State Univ., University Park.
ON NONPARAMETRIC TESTING OF THE NATURE OF CERTAIN TIME SERIES
Walter B. Miller and Henry Rachele *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 391–414 refs (See N68-13581 04-31)

Nonparametric tests were adapted and used to determine if a given set of samples from a time series is stationary, τ-dependent and Markov. Results obtained from testing a number sequence generated by a random number generator and sets of wind speed and direction data collected at White Sands Missile Range are presented. Author

N68-13597# Sandia Corp., Albuquerque, N. Mex. Aero-Thermodynamics Dept.
A TECHNIQUE FOR PREDICTING NONLINEAR WIND COMPENSATION OF BALLISTIC ROCKET SYSTEMS
G. G. Wilson *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 415–430 ref Sponsored by AEC (See N68-13581 04-31)

Factors affecting the nonlinearities associated with wind compensation of ballistic rocket systems are discussed. A linear wind compensation method, used by Sandia Laboratory since 1959, is presented and extended to account for nonlinear effects. Comparisons between the two methods are made to show expected improvements in accuracy. Author

N68-13599# Aerojet-General Corp., Sacramento, Calif. Aerothermodynamics Dept.
COMPUTER APPLICATIONS TO WIND WEIGHTING AND THEIR LIMITATIONS
Philip A. Sollow *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 449–490 refs (See N68-13581 04-31)

The currently employed wind weighting methods are reviewed and the inaccuracies inherent in this system are discussed. Examples are presented of a number of different wind weighting curves derived for the same vehicle without violating the accepted concepts of deriving these curves. It is shown that these same inaccuracies exist in the use of ballistic factors. A method of using the contemporary technique with improved accuracy is discussed and approaches which show promise of major improvement in the accuracy of wind weighting are presented. A measured wind profile includes both steady winds and turbulent winds. Wing weighting is properly done for the steady winds, but not for the turbulent winds which change rapidly with time. It is shown that the measured wind profile may be reduced to the steady wind profile through appropriate filtering. A method of determining the dispersion due to turbulent wind from the power spectrum of this wind is discussed, and a sample determination is presented. It is shown that if the measured wind profile is not filtered, it is advantageous to make launcher setting corrections which are smaller than those called for by wind weighting. Author

N68-13601# New Mexico State Univ., University Park.
COMPUTATION OF MEAN WIND SPEED FROM BALLOON TRACK
Louis D. Duncan and Bernard F. Engebos *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 533–537 (See N68-13581 04-31)

It is shown that the mean wind through a given altitude layer can be determined from balloon tracking data without computing wind values for individual points. The assumptions involved in the procedure are similar to the assumption made in numerical differentiation techniques, i.e., the position can be approximated by a polynomial. Author

N68-13602# New Mexico State Univ., University Park.
BLUE GOOSE WIND CORRECTION ANALYSIS
Urban H. DeH. Lynch *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 539–603 ref (See N68-13581 04-31)
(Contract AF 29(601)-6311)

Described are techniques to develop accurate wind compensation for unguided vehicles. This work was performed as a requirement for a new sounding rocket named the Blue Goose. Analytical results for arbitrary wind profiles indicate that the technique can correct the trajectory to within 0.2 degree dispersion. Inherent in the quoted trajectory accuracy is the need for accurate wind tunnel data (to include high angle of attack aerodynamics at low Mach number) for the vehicle and a proven six-degree-of-freedom trajectory calculation. Author

N68-13623# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.
A BALLOON SONDE FOR MEASURING X-RAYS AND SOLAR ULTRAVIOLET RADIATION [EINE BALLONSONDE ZUR MESSUNG VON ROENTGENSTRAHLUNG UND SOLARER ULTRASTRAHLUNG]
E. Waibel 1963 47 p refs In GERMAN Sponsored in part by AF Office of Sci. Res. and Max–Planck Ges.
(Rept.-10/1963) CFSTI: HC $3.00/MF $0.65

An apparatus equipped with a scintillation counter and a counter telescope was developed for use in balloon ascents. This combination of equipment makes it possible to measure both the X-rays and the corpuscular radiation that occur in the auroral zone of the stratopshere. In particular, short-duration fluctuations of weak intensities and also the energy spectra can be investigated. Radio transmission enables the measurements to be recorded on the ground. The first three sets of experimental equipment have already been successfully tried out at Kiruna (Northern Sweden); they worked perfectly over a broad temperature range on balloon flights lasting thirty hours. Author (ESRO)

N68-13624# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.
THE EFFECT ON THE MESON AND NUCLEON COMPONENTS AT GROUND LEVEL OF VARIATIONS IN PRIMARY COSMIC RADIATION [AUSWIRKUNG DER VARIATIONEN DER PRIMAEREN KOSMISCHEN STRAHLUNG AUF DIE MESONEN- UND NUKLEONENKOMPONENTE AM ERDBODEN]
Hermann Erbe (Ph.D. Thesis—TH Stuttgart) 1959 39 p refs In GERMAN Sponsored by Deut. Forsch. Gemeinschaft
(Rept.-2/1959) CFSTI: HC $3.00/MF $0.65

Between the autumn of 1956 and the end of 1957, eight balloons were launched from Weissenau for the purpose of recording cosmic radiation at great heights. The measurements obtained from seven of the flights show that, in normal circumstances, the relative fluctuation of cosmic radiation varies linearly with height. The fluctuation becomes greater as the height increases. The variation in nucleon components and mesons bears the same relationship to the change in primary radiation as do the latitude effects of these components. From this relationship it is possible to calculate the change in the primary spectrum. It corresponds with a modulation due to fluctuations of the electrostatic potential of earth and its surroundings vis-a-vis outer space. On two ascents, additional radiation was recorded at great heights, probably of solar origin. On one flight, an effect was observed that can be explained by the assumption that the sounding balloon flew through a radioactive cloud extending from a height of 18 km to a height of about 29 km. Author (ESRO)

N68-13634# Geoscience, Inc., Cambridge, Mass.
PROGRAMS FOR THE ANALYSIS OF MAGNETO-TELLURIC DATA. PART 2: TAPE EDITING
James N. Galbraith, Jr. Apr. 1967 52 p
(Contract Nonr-4900(00))
(RU-67002; AD-661844)

An editing program (DGEDT1) has been prepared to accept data tapes generated on the magneto-telluric digital field system and correct all digitizer-caused errors and generate demultiplexed data tapes which can be read by the analysis program. The merge program (DGMRG1) was written to reduce the number of data tapes required to hold the edited output. This program merges two or more DGEDT1-format tapes onto a single output tape. A table of contents of the output tape is generated so that the successful operation of the program does not depend on the operator mounting the tapes in any particular order. The listings of the two main programs, complete with their documentation, and of all special-purpose subroutines used by them are given. TAB

N68-13726# Brookhaven National Lab., Upton, N. Y. Biology Dept.
THERMOLUMINESCENCE INDUCED BY LOW-ENERGY ALPHA PARTICLES
Robert G. Woodley and Noye M. Johnson (Dartmouth Coll.) *In* NRL Luminescence Dosimetry Apr. 1967 p 502–506 refs (See N68-13681 04-14)

Low-energy α particles are approximately 10% to 20% as effective as γ radiation in producing thermoluminescence for equal absorbed doses in the phosphor. Experimental determination was made by irradiating powdered samples of CaF_2 and $CaCO_3$ with ^{210}Po α particles and powdered samples of LiF with thermal neutrons. The thermal-neutron irradiation results in the $^6Li(n, \alpha)^3H$ reaction. The geometry of the phosphor crystals was arranged to ensure homogeneous irradiation of the samples. Comparisons were made with equivalent samples that had been irradiated with ^{60}Co γ radiation. The mode of ionization of α particles in the materials of this experiment evidently is less efficient than β or γ radiation for filling electron traps. Author

N68-13730 Joint Publications Research Service, Washington, D. C.
CHOICE OF CORRESPONDENCE OF THE TIME INTERVAL BETWEEN TWO MEASUREMENTS TO THE TIME CONSTANT OF AN INSTRUMENT
K. D. Sabinin 26 Dec. 1967 14 p refs Transl. into ENGLISH from Fiz. Atm. i Okeana (USSR), v. 3, no. 5, May 1967 p 473–480
(JPRS-43835) CFSTI: $3.00

The effect of discrete sampling (aliasing) is illustrated with two examples, one of which is based on the calculated data obtained in the Atlantic Ocean, and the other is for a case where the actual spectrum varies in accordance with the rule of 5/3. A monograph is offered for selecting the optimum correspondence of the time-interval between two readings to the time constant of the

measuring device. It is shown that the ratio of these two values should be in a range from 1 to 3.5. In such a case, with a Nyquist-frequency within 0.1 to 0.5, the spectrum values will not be significantly distorted by the aliasing or by the inertial properties of the measuring devices. Author

N68-13731# Arctic and Antarctic Scientific Research Inst. (USSR).
TEN YEARS OF SOVIET GEOGRAPHIC EXPLORATIONS IN ANTARCTICA [DESYAT'LET SOVETSKIKH GEOGRAFICH-ESKIKH ISSLEDOVANIY ANTARKTIKI]
K. K. Markov et al 9 Oct. 1967 17 p Transl. into ENGLISH from Inform. Bull. of the Soviet Antarctic Expedition (USSR), no. 57, 1966 p 21–27
(AD-661183)

In antarctica the Soviet geographers studied the relief (geomorphology) of its rocky and glacial surface. The snow-fern depth, climate, waters, wind-worn crust, animal life and vegetation. Soviet cartographic (geodetic) investigations were conducted in the coastal and interior areas of the continent, and also the bottom areas of the Southern Ocean, adjacent to Antarctica. Cartographic-geodetic investigations in the interior helped to determine the main outlines of the Eastern Antarctic glacial shield. It was found that the Continent extends below the surface of the ocean in the form of a coastal shoal or shelf, followed by a continental decline. Important features of the submerged portion of the Continent were determined by sounding devices and recorded on a bathymetric chart.
Author (TAB)

N68-13749 Adelaide Univ. (Australia). Physics Dept.
A LOCAL MAGNITUDE SCALE FOR SOUTH AUSTRALIAN EARTHQUAKES
R. E. White Oct. 1967 34 p refs

A magnitude scale has been developed for South Australian earthquakes which is simple and consistent. It is based on the maximum trace amplitude among the S waves recorded on vertical component Benioff seismographs, and applies to distances up to 3.6 degrees. The extension of the Richter local magnitude scale to Benioff and other highly sensitive instruments to study small magnitude earthquakes has drawbacks and, in the present case, could lead to significantly erroneous estimates of magnitudes. An application of the "time-term" method to the study of amplitudes has produced a satisfactory agreement with theory. Tentative relations are given between the South Australian scale and other scales and an energy-magnitude relation is derived. The maximum S ground velocity between 1° and 3° is due to the reflection from the M discontinuity. Author

N68-13769# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany).
THE GEOPHYSICAL EVENTS OF 12–14 NOVEMBER 1960 [DIE GEOPHYSIKALISCHEN EREIGNISSE DES 12. BIS 14. NOVEMBER 1960]
Walter Dieminger, comp. 1962 75 p refs In GERMAN
(Rept.-8/1962) CFSTI: HC $3.00/MF $0.65

The geomagnetic storm of 12–14 November 1960 brought out a whole series of interesting details. This paper describes as precisely as possible the way in which the geophysical phenomena manifested themselves in the Göttingen–Lindau area. No attempt is made of any interpretation of the significance of the phenomena that goes beyond what was already known. Such interpretation can only be undertaken on the basis of a world-wide analysis of all observations. This paper is intended as a contribution thereto and reports on vertical soundings of the ionospheric absorption, radio-wave propagation, cosmic rays and includes also some observations made from other locations to enable a better picture of the overall situation. ESRO

N68-13779# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ELECTRON MICROPROBE ANALYSIS AND MICROSCOPIC STUDY OF POLISHED SURFACES OF MAGNETIC SPHERULES AND GRAINS COLLECTED FROM THE GREENLAND ICE
Ahmed El Goresy 13 Oct. 1967 38 p refs
(SAO Special Rept.-251)

Several magnetite spherules contain metallic cores. The metallic cores of three spherules are composed of nearly pure αFe with traces of Ni. The metallic nuclei of two other spherules contain appreciable amounts of Ni; the nucleus of one of these is composed of a Ni-rich NiFe alloy (96.9% Ni) and that of the other contains 3% Ni. This latter spherule is probably of cosmic origin, perhaps formed in the fusion crust of an iron meteorite. The majority of the spherules consist of magnetite, which is more or less transected by martite lamellae parallel to {111} planes of the magnetite. A single composite grain of titanomagnetite, ilmenite, hematite, and pyroxene was also found. This grain is of terrestrial origin, probably derived from the metamorphic crystalline complex of Greenland. The mineralogy and chemistry of the magnetite spherules and grains studied are also discussed in detail. Author

N68-13793 Los Alamos Scientific Lab., N. Mex.
SHOCK-WAVE EQUATION OF STATE FOR HIGH-DENSITY OXYGEN
Jerry Wackerle, W. L. Seitz, and John C. Jamieson [1967] 14 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967 Sponsored by AEC

High explosives were used to produce planar single and double shock waves in liquid oxygen at 76.9±0.2°K with a density of 1.202±0.001 g/cc^2. A streak camera provided sixfold redundance on recording flash-gap closures; time offsets read from the film were measured to yield shock velocities in each sample. Accurate determinations of shock parameters were computed by using Hugoniots and the Gruneisen equation of state. Results for shocks reflected from gold and copper plates are given in tables. G.G.

N68-13806# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.
ON THE CONNECTION BETWEEN X-RAY BURSTS IN THE AURORAL ZONE AND BAY-TYPE GEOMAGNETIC DISTURBANCES [UEBER DEN ZUSAMMENHANG ZWISCHEN ROENTGENSTRAHLUNGS-AUSBRUECHEN IN DER POLARLICHTZONE UND BAYARTIGEN ERDMAGNE-TISCHEN STOERUNGEN]
Gerhard Kremser 1964 61 p refs In GERMAN
(Rept.-14/1964) CFSTI: HC $3.00/MF $0.65

All major X-ray bursts are shown to coincide with bay-type geomagnetic disturbances. Some general conclusions are reached—including the assumption that although the two phenomena have common causal connections, they are otherwise largely independent; and the hypothesis is discussed that the X-ray bursts may belong to an overall complex of events in the auroral zone, all occasioned by the incursion of particles and in some way inter-related via the as yet not fully-known acceleration mechanism. ESRO

N68-13821 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: DAPANGO (TOGO); 10°48'N, 0°04'E, JUNE 1966 [IONOS-PHAEREN-DATEN, VERTIKAL-ECHO-LOTUNG: DAPANGO (TOGO); 10°48'N, 0°04'O, JUNI 1966[

Jun. 1966 39 p In ENGLISH and GERMAN
CFSTI: $3.00

Tabulated ionospheric data obtained by vertical echo soundings at Dapango, Togo are presented. R.N.A.

N68-13829*# Chicago Univ., Ill. Dept. of Geology.
A SIMPLIFIED GRID TECHNIQUE FOR DETERMINING SCAN LINES GENERATED BY THE TIROS SCANNING RADIOMETER
James E. Arnold May 1965 23 p refs
(Grants NsG-333; CWB-WBG-6)
(NASA-CR-91379; SMRP-RP-32) CFSTI: HC $3.00/MF $0.65
CSCL 04B

A grid method for the construction of scan lines generated by the TIROS scanning radiometer is presented. Making use of a series of scan line grids constructed for tilt intervals of one degree and a height range from 700 to 1000 km the user can quickly generate scan lines on an OEC projection for the geographic area in which the analysis of the radiation data is to be performed. A brief outline of the grid geometry and construction is given along with an explanation of how the grids should be used. Author

N68-13890 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, ABSORPTION MEASUREMENTS: FREIBURG, URSI-CODE 131; 48° 03' 18" N, 07° 35' 24" E, JULY–SEPTEMBER 1967 [IONOSPHAEREN-DATEN, ABOSRPTIONS-MESSUNGEN: FREIBURG, URSI-CODE 131; 48° 03' 18" N, 07° 35' 24" O, JULI–SEPTEMBER 1967]
1967 8 p refs In GERMAN
CFSTI: $3.00

Daily and monthly average ionospheric absorption losses obtained by echo amplitude soundings are reported for July, August, and September of 1967 as measured by the Freiburg, Germany, station. Transl. by K.W.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N68-12818 Wisconsin Univ., Madison. Santa Barbara Research Center, Goleta, Calif.
ATS SPIN–SCAN CLOUD CAMERA AND PRELAUNCH CALIBRATION PROCEDURE
In its Studies in Atmospheric Energetics based on Aerospace Probings Mar. 1967 p 1–40 Prepared jointly with Santa Barbara Res. Center (See N68-12817 04-13)

Design details and specifications are presented on the spin–scan cloud camera, which consists of a high resolution telescope and a photomultiplier light detector coupled with a precision latitude step mechanism. This mechanism combined with the spinning motion of the synchronous Applications Technology Satellite (ATS) provides complete coverage of the earth from 52.5° north latitude to 52.5° south latitude and from the west limb to the east limb. Ground commands and telemetry outputs associated with the camera are also described. To provide the required test features, a special calibration instrument was constructed to check camera performance. Primary purposes of the calibration were to establish the relationship between the energy intercepted by the camera as it views a suitable target illuminated by sunlight and the camera output signal, and to set the level of the camera signal so typical targets on the earth will generate voltages which fall within the design range of the satellite telemetry system. The difficulties encountered in the procedure are discussed, and the measurement data obtained are assessed. M.G.J.

N68-12822 Wisconsin Univ., Madison.
THE "CHIRP" DIGITAL RADIOSONDE
Verner E. Suomi, Kirby J. Hanson, and Robert J. Parent *In its* Studies in Atmospheric Energetics Based on Aerospace Probings Mar. 1967 p 101–109 refs (See N68-12817 04-13)

The system employs a simple concept in which a voltage pulse, proportional to a sensor voltage, is used to generate a burst of pulses from a voltage controlled oscillator (VCO). A count of the high frequency oscillations which make up the chirp provides the digital measurement. The system is adapted to multiple sensor use with a multiplexer. The system has the advantage in that one has the option of selecting an ac amplifier for low level signals in conjunction with a variety of multiplexers and VCO for the desired measurement. One particular combination of multiplexer and VCO was used to demonstrate its use as a digital radiosonde. A flight test of the digital radiosonde was obtained. Results clearly show fine structural detail in the temperature profile without any need for subjective interpretation by the operator. Numerous isothermal and inversion layers less than 100 m in thickness were observed. The digital radiosonde used conventional (U.S. Weather Bureau) temperature and humidity sensors. Temperature resolution is about 0.1°C and relative humidity is about 0.1%. The system resolution is 0.1%. Author

N68-12823 Wisconsin Univ., Madison.
THE PROTOTYPE DATA LOGGING SYSTEM FOR THE ESSA 2 FLAT-PLATE RADIOMETERS
David F. Nelson *In its* Studies in Atmospheric Energetics Based on Aerospace Probings Mar. 1967 p 111–118 (See N68-12817 04-13)

Details are given on a data logging system designed to provide four functions: (1) digitize the resistance of external sensing elements such as thermistors; (2) provide sensor commutation so that several sensing elements can be measured in sequence; (3) store the digital data on magnetic tape; and (4) play back the stored data on external command. The system requires minimum power and operates over a temperature range of −20°C to +60°C. It is packaged to survive environmental tests specified for the TOS spacecraft. The operation of the system is discussed. Author

N68-12824 Wisconsin Univ., Madison.
THE PROTOTYPE FLAT-PLATE RADIOMETERS FOR THE ESSA 3 SATELLITE
David F. Nelson and Robert Parent *In its* Studies in Atmospheric Energetics Based on Aerospace Probings Mar. 1967 p 119–129 (See N68-12817 04-13)

For measuring the global distribution of the reflected solar and long wave radiation leaving the earth, two sensor configurations were designed for the sensor array. These are a flat plate radiometer with no attempt to restrict the field of view, and a flat plate radiometer with cone optics to reduce or eliminate sensor response to direct solar radiation. Design details are given for each. Black and white sensors are used in each configuration to obtain two spectral response characteristics: the black sensor responds to the sum of the direct solar, reflected solar, and long wave radiation from earth; the white sensor absorbs most of the long wave radiation from the earth, but reflects much of the solar radiation incident on it. The sensor/spacecraft interface is also discussed. M.G.J.

N68-12830 Australian National Univ., Canberra. Research School of Physical Sciences.
THE USE OF A POSITION-SENSITIVE SOLID STATE DETECTOR TO MEASURE PROPERTIES OF A MAGNETIC SPECTROMETER
R. V. Elliott, K. W. Carter, and R. H. Spear [1966] 27 p refs
(ANU-P/387)

A technique based upon the use of a position-sensitive solid state detector was developed for measuring properties of a 61 cm double-focussing magnetic spectrometer. It has proved particularly convenient for determining the position of the focal plane. Author

N68-12859* Airborne Instruments Lab., Deer Park, N. Y.
FLIGHT BURST RADIOMETER SYSTEM FOR RADIO ASTRONOMY EXPLORER SATELLITE Final Report
Jul. 1967 72 p ref
(Contract NAS5-9340)
(NASA-CR-91288) CFSTI: $3.00 CSCL 20F

The solar burst radiometer system is used to measure the spectral distribution of solar bursts at frequencies below the ionospheric cutoff frequency. The satellite monitors phenomena caused by the interaction of electrons with the solar corona. The radiation burst characteristics are measured in the 200 kc to 6 Mc frequency range. The radiometer has the secondary function of determining the level of continuous galactic emission. The radiometer equipment is contained in three separate packages; two preamplifiers and the main assembly. Two radiometers contain eight frequency channels each. The third unit contains six fixed-frequency channels and a variable frequency channel. The variable channel is programmed to step sequentially through the 200 kc to 6 Mc range in 32 steps, sampling a discrete frequency at each step. All three units contain a solid-state noise source which can be electronically controlled to provide seven calibration levels. Author

N68-12862 National Bureau of Standards, Washington, D. C.
DRAWINGS OF MICROMETER U-TUBE MANOMETERS FOR THE RANGES UP TO 100 MM OF MERCURY
A. M. Thomas and J. L. Cross 26 Aug. 1967 18 p refs
(NBS-TN-420) GPO: $0.15

Drawings with sufficient detail are presented so that micrometer U-tube manometers for use with mercury, oil, and water may be constructed. Measurements made with the oil manometer have an uncertainty of about 4×10^{-4} mm of Hg plus one part in 10^4 of the reading. Measurements made with the mercury manometer have an uncertainty of about 4×10^{-3} mm of Hg plus eight parts in 10^5 of the reading. Author

N68-12883# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
A MULTIBULB VISCOMETER
H. A. Kermicle 13 Jun. 1967 16 p refs
(Contract W-7405-ENG-26)
(K-1696) CFSTI: HC $3.00/MF $0.65

A three-bulb glass viscometer for semiautomatically determining the efflux times of a liquid at three different consecutive shear rates is described. Data are obtained by measuring the time required for the sample level to fall between a pair of meniscus detectors located above and below each blub along a vertical tube. The meniscus detector assemblies utilize a common exciter lamp, flexible fiber-optics light pipes to transmit the optical signals, and photoconductive cell bridges. Solid state amplifiers are employed to actuate precision timers which store the efflux time data until reset. The timer storage capacity is 1000 seconds in 0.1 second increments, and a readout resolution of ±0.02 seconds can be attained by interpolation. A maximum overall error (95% C.I.) of 0.14 second was obtained using a distilled water sample in a stirred but not temperature-controlled water bath. The sample requirement for the instrument is 4.5 to 5.5 ml. Author (NSA)

N68-12920 Naval Research Lab., Washington, D. C.
AIRGLOW HORIZON PHOTOGRAPHY FROM THE GEMINI SPACECRAFT
M. J. Koomen, R. T. Seal, Jr., and J. Lintott *In its* Rept. of NRL Progr. Apr. 1967 p 5–11 refs (See N68-12918 04-34)

A large number of photographs of the night airglow layer at various geographical locations were obtained during several flights in the Gemini series. These were taken from the pilot's window of the spacecraft with an f/0.95, 50-millimeter focal length camera that was optically filtered to photograph spectral regions centered at 5577A and 5893A, where prominent airglow emissions occur because of atomic oxygen and sodium, respectively. Filter combinations with broader spectral coverage also were used. Fine pointing of the camera was done with an illuminated camera sight and an adjustable camera mount. The photographs were taken as a part of the airglow horizon photography experiment. Photographs from the Gemini IX and XI flights show variations in intensity and altitude of the airglow emissions. Reduction of the data from the Gemini XII flight is expected to reveal similar results. Author

N68-12929*# Perkin-Elmer Corp., Pomona, Calif.
A HIGH PRESSURE MAGNETIC ION SOURCE Final Report
Jul. 1967 91 p refs
(Contract NAS5-3453)
(NASA-CR-91381) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A theoretical analysis developing the design equations for extending ion source operation to higher pressures has resulted in a test model capable of direct analysis of pressures up to 1×10^{-2} torr. Close agreement between the theory and the test results was obtained, and the operating pressure range of the test model was extended to 1×10^{-1} torr. The objective of the study was to produce a source capable of operation at 1×10^{-2} torr having a sensitivity of 1×10^{-8} amperes/torr without exceeding a time response of 0.030 seconds. Test of the instrument gave operation to 1×10^{-1} torr with a sensitivity of 8×10^{-9} amperes/torr. The time response was analyzed using a computer program, and for the defined interfacing system gave a response of .0025 seconds to 95% of a stepped pressure change. Author

N68-12937*# ITT Industrial Labs., Fort Wayne, Ind.
A DAY–NIGHT HIGH RESOLUTION INFRARED RADIOMETER EMPLOYING TWO-STAGE RADIANT COOLING Quarterly Report, 1 Apr.–1 Jul. 1967
R. V. Annable, J. F. Lodder, R. A. Harber, W. H. Wallschlaeger, and G. Eiden 15 Jul. 1967 53 p
(Contract NAS5-10113)
(NASA-CR-91389; ITTIL-67-1035; QR-5) CFSTI: HC $3.00/MF $0.65 CSCL 20F

This report describes the initial testing of a two-stage radiant cooler to be used in a 10.5 to 12.5 micron day–night high resolution infrared radiometer and outlines the initial electronic design of a breadboard radiometer. A complete two-stage patch assembly passed sinusoidal vibration tests at Nimbus prototype levels. Thermal tests on single-stage models of the radiant cooler showed that evaporation of aluminum and gold on Alzak treated aluminum does not produce a suitable cone surface, while aluminized mylar produces a cone surface whose emissivity is within the design range (0.086 to 0.02). The average cone surface emissivity including support and optical openings is 0.063 in the cooler employing aluminized mylar; this corresponds to an in-orbit patch temperature of 98 degrees K in a single-stage cooler. The helium refrigerator and attached copper structure used to simulate cold space during cooler tests operated close to design values following modification of the support and coupling of the refrigerator. The status of the electronic test equipment is given and the design of the relay optics is outlined. Finally, the initial design of the radiometer electronics is covered. Author

N68-12985* ITT Industrial Labs., Fort Wayne, Ind.
IMAGE DISSECTOR CAMERA SYSTEM Quarterly Report, Dec. 2, 1966–Mar. 2, 1967
W. E. Koenig and C. W. Steeg, Jr. 18 Aug. 1967 83 p
(Contract NAS5-9619)
(NASA-CR-91357; ITTIL-67-1041; QR-7) CFSTI: $3.00 CSCL 14D

Qualification and acceptance test data are presented on a prototype image dissector camera system being developed to provide daytime cloud cover television pictures from the Nimbus satellite. Schematics are included, and the telemetry curves are plotted. The construction of the flight models is discussed, with details given on the modifications made to the electrical and mechanical systems, video level adjustment, flatpack solder connections, high voltage power supply potting technique, low voltage power supply failure, fabrication, and conformal coatings. M.G.J.

N68-12971 Drexel Inst. of Tech., Philadelphia, Pa.
AN AUTOMATED METEOROLOGICAL INSTRUMENTATION AND OBSERVING SYSTEM ON A 1000 FT. TELEVISION TOWER Final Report
H. Newstein 30 Sep. 1966 140 p
(Contract CWB-10608)
(PB-173860) CFSTI: $3.00

Design and construction details are given on an automatic meteorological observing station which was installed to acquire wind, temperature, and dew point data in the lower 1000 ft layer of the atmosphere. Sensors are installed at five levels on the tower: 100, 200, 350, 570, and 890 ft. A separate analog recorder is used with each sensor, and temperature and dew point measurements are also made in an instrument shelter at the base. A digital recording subsystem, which includes a small analog computer, causes the sensors to be sampled at prescribed intervals and the data to be punched on cards. Because of the rather large time constant of the temperature and dew point sensors, instantaneous sampling is adequate. The analog computer is used for averaging the winds over prescribed intervals before digitization. M.G.J.

N68-13005 National Bureau of Standards, Washington, D. C. Spectrochemical Analysis Section.
SCANNING ELECTRON PROBE MICROANALYSIS
Kurt F. J. Heinrich 3 Feb. 1967 43 p refs Presented at the 69th Ann. Meeting, ASTM, Atlantic City, Jun. 1966 Submitted for publication
(NBS-TN-278) GPO: $0.30

The combination of electron microprobe x-ray emission spectrometry with the scanning techniques first developed for the scanning electron microscope permits using the scanning electron probe as a microscope sensitive to elemental composition. This technique is particularly useful in the many applications in which spatial distribution of one or more elements in a specimen is more important than local composition. Although oscilloscope representation of probe scanning is usually obtained by the simple technique of producing a dot of light for each arriving photon, more sophisticated scanning techniques such as expanded constrast registration and concentration mapping can provide more quantitative information. Signals other than x-rays, such as target current, electron backscatter, or cathodoluminescence may be used for image formation. Electron beam scanning can also be performed in a discontinuous fashion, so that the electron beam irradiates in succession a number of spots arranged in a square or rectangular pattern, and the number of photons registered in each position is retained in the memory of a multichannel analyzer. The application of these diverse scanning techniques is illustrated. Author

N68-13012# Los Alamos Scientific Lab., N. Mex.
A MODIFIED-SPHERE NEUTRON DETECTOR
Dale E. Hankins 17 Jan. 1967 39 p refs
(Contract W-7405-ENG-36)
(LA-3595) CFSTI: HC $3.00/MF $0.65

Calculations were made using the adjoint-transport program to determine the response of a neutron detector using cadmium-loaded polyethylene spheres of 8-, 9-, and 9-1/2-in diameter. The effect on the energy response of the detector is given as a function of cadmium thickness and location of the cadmium in the sphere. The effect on the energy response of a void in the sphere, subsitution of boron for cadmium, and the use of a perforated cadmium layer were also calculated. A 9-in cadmium-loaded sphere was made using the calculated cadmium location and thickness. The response curve to fast and thermal neutrons was compared to the calculated value. The 9-in cadmium-loaded sphere was found to have a response similar to that of the 10-in rem-responding sphere. Author

N68-13032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE CALCULATION OF INERTIA OF AN INSTRUMENT DURING METEOROLOGICAL MEASUREMENTS [OB UCHETE INERTSII PRIBORA PRI METEOROLOGICHESKIKH IZMERENIYAKH]
R. L. Kagan 18 Aug. 1967 16 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 174, 1965 p 21–34
(FTD-MT-66-82; AD-661383)

An analysis is made of the problem of accuracy of readings of an inertial device which characterizes the instant and averaged values of the measured magnitude. The effect of inertia on the correlative functions obtained by an experimental method is evaluated. TAB

N68-13050# National Bureau of Standards, Washington, D. C.
A SURVEY OF IONIZATION VACUUM GAGES AND THEIR PERFORMANCE CHARACTERISTICS
W. G. Brombacher 3 Feb. 1967 65 p refs
(NBS-TN-298) GPO: $0.40

The design of various types of ionization gages is outlined, with particular attention to the design elements important to performance. The performance and the many factors affecting the performance of the various gages are reviewed. Methods of calibration are discussed in some detail, including the use of volumetric pressure dividers, conductance pressure dividers and constant rate of pressure change methods. About 365 references to the literature are cited. Author

N68-13124# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN AUTOMATIC CONTROL SYSTEM FOR A STELLAR INTERFEROMETER [SISTEMA AVTOMATICHESKOGO UPRAVLENIYA ZVEZDNYM INTERFEROMETROM]
Yu. A. Sabinin and P. V. Nikolayev 23 Jan. 1967 26 p refs Transl. into ENGLISH from Sb. Rabot Po Voprosam Elektromekhan. (Moscow), no. 9, 1963 p 161–175
(FTD-HT-366; AD-661762)

The automatic interferometer control system has 3 principal subsystems which also specify its performance: an automatic guiding subsystem which points the instrument, mounted on an azimuthal platform, toward any point in the sky which is given in equatorial coordinates; a coarse tracking subsystem; a photoelectric guiding subsystem. After the desired equatorial coordinates of the star (direct ascent and declination) and the proper stellar times are selected on the control panel, the guiding subsystem guides the interferometer tube toward the star at a velocity of 200 rev/24 hrs and with an accuracy of plus or minus 10 seconds of arc. Then the astronomer readjusts the pointing accuracy visually and by manual controls. After this the coarse tracking subsystem is switched

in and the photoelectric guiding subsystem whose field of view is 2 sec. of arc, is also turned on. The stellar time variable is supplied continuously to the system and the tracking proceeds according to the motion of the earth. The guiding and coarse tracking subsystems use the same basic components with few additional signals being switched in and out for each operation. The tracking system (for both A and H axes) consists of an electronic amplifier, an amplidyne, driving motor, tachometer, reduction gear and angular error signal sources. An AGC system is used in azimuth tracking. Author (TAB)

N68-13131# United Kingdom Atomic Energy Authority, Harwell (England). Authority Health and Safety Branch.
AN INVESTIGATION OF THE ACCURACY ATTAINED IN THE ROUTINE USE OF THE AERE/RPS FILM DOSEMETER
N. Adams and W. A. Langmead Feb. 1966 34 p refs
(AHSB(RP)R-65)

An experiment has been performed to provide data on the accuracy attained in the routine assessment of radiation doses to personnel with the AERE/RPS film dosemeters. AERE/RPS dosemeters were supplied for irradiation with doses of x, gamma, and beta radiation, known only to the authors. The dosemeters were then returned for dose assessment. Twelve of the dosemeters received irradiations comparable to those given in a similar investigation carried out in 1961/62 when a simpler film dosemeter was in general use in the Authority. For these irradiations the AERE/RPS dosemeters enabled dose assessments of much improved accuracy to be made; the proportion of assessments having large errors (i.e., greater than ±40%) was reduced to 11% from a value of 21% obtained with the earlier dosemeter. Even more significant was the elimination of the very large over-estimates of dose obtained for some x- and gamma-ray mixtures with the earlier dosemeter as a consequence of its inability to identify a soft radiation component as x rays or beta rays. Six additional irradiations were designed to provide a more searching test of the performance of the AERE/RPS dosemeter and to demonstrate this dosemeter's capabilities and some of its known limitations. Author (NSA)

N68-13143* Honeywell, Inc., Boston, Mass. Radiation Center.
AMES MAGNETOMETER EXPERIMENT FOR AIMP D AND E
Burton A. Pearlstein Oct. 1967 153 p
(Contract NAS2-2597)
(NASA-CR-73161; HRC-67-72) CFSTI: $3.00 CSCL 14B

Detailed engineering design data are presented on the magnetometer experiment for measuring the magnitude, direction, and spatial and temporal variations of the magnetic field in interplanetary space as the spacecraft orbits the moon. Each major subsystem is described, and the design approaches chosen and the problems encountered are discussed. The system includes a sensor package mounted at the end of a six foot boom; an electronics package located within the spacecraft main structure; a signal processing subsystem with the basic functions of spin demodulation, low pass filtering, and amplitude compression; a data handling subsystem to provide the interface between the periodic sampling and readout to telemetry; flip and calibrate electronics to check on system performance during flight; spacecraft perm (bypass channel) and flag electronics; and power supply electronics. Summary information is provided on the ground support equipment and go-no-go tester. Acceptance test data are included, along with complete system schematics and major assembly drawings. M.G.J.

N68-13208* General Applied Science Labs., Inc., Westbury, N. Y.
K-BAND ELECTRON DENSITY PROBE Final Report, 25 Aug. 1966-25 May 1967
Hector Medecki, Manlio Abele, and David Attwood 25 May 1967 32 p refs
(Contract NAS5-10051)
(NASA-CR-91382; TR-662) CFSTI: $3.00 CSCL 14B

Development details are given on an electron density probe with a measurement capability extending from 10^{10} to 10^{14} e/cm^3 in the separated flow field of an Apollo spacecraft model under superorbital shock tunnel conditions. The operating wavelength of the K-band probe was reduced to 1 cm. The range of resonant frequencies was also reduced to a value which is conveniently generated with a single electronically modulated klystron. A phase shift measurement of resonant frequency is used rather than the simple amplitude measurement used with the previously developed X-band (3 cm wavelength) probe. Although the first model K-band probe has too large a thermal sensitivity for the proposed applications, design modifications are suggested to remove these restrictions. M.G.J.

N68-13224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTRUMENT FOR CONTACTLESS MEASURING OF PARAMETERS OF THIN SEMICONDUCTIVE FILMS [PRIBOR DLYA VESKONTAKTNOGO IZMERENIYA PARAMETROV TONKIKH POLUPROVODNIKOVYKH PLENOK]
M. K. Sheynkman and I. B. Shul'ga 21 Feb. 1967 10 p ref Transl. into ENGLISH from the Publ. Mashiny i Pribory Dlya Ispytaniya Metallov i Plastmass, Mashimostr. (Moscow) 1965 p 112-116
(FTD-HT-66-414; AD-661905)

A device for rapid measurement of parameters of semiconductor films is described. The apparatus removes the need for direct contact of electrodes upon test specimens and permits the study of parameter distribution along the film, as well as the investigation of kinetic photoelectric processes. A circuit diagram of the device is given. Special elements in its network include a 6NZP lamp and an ENO-1 oscillograph. The authors describe in detail the functions of the more important items in the network, paying particular attention to the use of electrodes on two types of measurement condensers. A discussion of the variation of network current with different semiconductor film sizes and types is given. Author (TAB)

N68-13237 International Atomic Energy Agency, Vienna (Austria).
RADIATION PROTECTION STANDARDS FOR RADIOLUMINOUS TIMEPIECES
Sep. 1967 48 p refs *Its* Safety Ser. No. 23

Recommendations of the European Nuclear Energy Agency and the International Atomic Energy Agency on radiation protection standards for timepieces containing radioluminous painted components. These standards are intended to protect the general public from overdoses of exposures to ionizing radiation; and both general and specific requirements related to paint selection for components and to casing and marking are prescribed. Control procedures for radioluminous timepieces are outlined, and the selection of radionuclides to be used for this purpose is considered in detail. Attention is also given to radiation protection procedures and the determination of maximum permissible activities of radionuclides used for timepieces. M.W.R.

N68-13239# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Sec.
DISTORTION OF COORDINATES OF AIR PHOTOS AND MODELS BECAUSE OF THE INFLUENCE OF ATMOSPHERIC REFRACTION AND CURVATURE OF THE EARTH'S SURFACE [ISKAZHENIYE KOORDINAT AEROSNIMKOV I MODELI VSLEDSTVIYE VLIYANIYA ATMOSFERNOY REFRAKTSII I KRIVIZNY ZEMNOY POVERKHNOSTI]
G. B. Gonin [1967] 28 p refs Transl. into ENGLISH from the Publ. "Fotogrammetricheskaya Obrabotka i Deshifrirovaniye Aerosnimkov" Leningrad, Nauka Publ., 1967 p 106-120
(ACIC-TC-1290; AD-661815)

The obtained formulas make it possible to compute the influence of atmospheric refraction and the curvature of the earths surface, with arbitrary angles of inclination of the aerial photographs.

Moreover, on the basis of derived formulas it is possible to give a quantitative evaluation of the appropriate corrections, depending on such parameters as the altitude of the survey, the terrain relief, and the type of the aerial camera. The obtained evaluations enables the determination of conditions under which corrections should be introduced and the influence of the curvature, or refraction disregarded. Author (TAB)

N68-13243# Naval Oceanographic Office, Washington, D. C.
APPARATUS FOR MEASURING THE INTENSITY OF COSMIC RAYS AT GREAT DEPTHS [USTANOVKA DLYA IZMERENIYA INTENSIVNOSTI KOSMICHESKIKH LUCHEY NA BOL'SHIKH GLUBINAKH]
Yu. N. Vavilov, B. A. Nelepo, G. I. Pugacheva, and V. M. Fedorov 1967 9 p refs Transl. into ENGLISH from Metody i Pribory Dlya Issled. Fiz. Protsessov v Okeane (Kiev), v. 36, 1966 p 31–36
(NOO-TRANS-378; AD-661754)

The use of a Cherenkov detector is suggested for the measurement of intensity of mu-mesons at great depths. The detector was tested in the Black Sea at depths as great as 1km. A diagram shows the recorded impulses. Some of the calculated values are tabulated to show the expected global intensity to depths of 5km which had been calculated with the aid of theoretically derived ratios for the vertical intensity of mu-mesons. Author (TAB)

N68-13272# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
SCANNING AND RECTIFICATION OF PANORAMIC PHOTOS
G. B. Gonin Oct. 1967 10 p refs Transl. into ENGLISH from the book "Fotogrammetricheskaya Obrabotka i Deshifrirovaniye Aerosnimkov" Leningrad, Nauka Publ., 1967 p 136–138
(ACIC-TC-1291; AD-661816)

The panoramic photographs of the surface of celestial bodies are generally taken from an arbitrary position of the photographing system. Therefore, for instance, the picture of the horizon on the photographs from station Luna-9 is interrupted in the middle part of the panorama. The rectification of such photographs to the ideal survey case, when the angular elements of external orientation are equal to zero, is important for the studies of extraterrestrial celestial bodies, because it makes it possible to present an undistorted situation, in particular the skyline about the automatic station. For the same reason the obtaining of a photographic picture on the plane print of central projection is of interest during a survey with nadir. Insofar as the picture on the panoramic photograph is constructed according to laws differing from central projecting, the solution of the formulated problem should be divided into two stages. The first stage consists of the scanning of separate sections of the panoramic photograph upon the plane. The second stage consists in the rectification of the scanned sections upon one or another plane. TAB

N68-13345 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR MEASUREMENT OF RAPIDLY CHANGING TEMPERATURE [USTROYSTVO DLYA IZMERENIYA BYSTROMENYAYUSHCHIKHSYA TEMPERATUR]
G. E. London *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 229–230 refs
(See N68-13323 04-19)

As a further development of existing experimental devices for measuring and regulating temperature or for measuring fluctuations in the velocity of a gas flow using thermocouples, the author proposes a device which accomplishes automatic correction of the time constant of the circuit in response to changes in the time constant (T) of the temperature sensitive element by introducing a magnetic coil in which the current flow is proportional to T. This device combines a resistance thermometer with a phase-leading circuit and a computer consisting of 3 amplifiers by which the derivatives of the temperature fluctuations are determined. Operation of the device requires that the ratio of resistance to inductance in the phase-leading circuit be proportional to T. Author

N68-13348*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
MANUFACTURE OF A SENSITIVE ANGLE MEASURING SYSTEM Final Report
6 Feb. 1967 19 p
(Contract NAS5-9383)
(NASA-CR-91469; FHR-3398; PCD-TR-67-1) CFSTI: HC $3.00/MF $0.65 CSCL 14B

System parameters, calibration equipment, and system verification and calibration are discussed for an angle measuring system for use in determining angular displacement at the Magnetic Gradient Free Facility at Goddard Space Flight Center. Specifications are given for the designed system which makes use of a capacitive motion sensing principle and delivers a minimum voltage output for a given angular displacement. M.W.R.

N68-13381 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugfuehrung.
THE SIMULTANEOUS OPERATION OF TWO TELEMETRY SYSTEMS FOR STRAIN GAGE MEASUREMENTS ON CONTRAROTATING PAIRS OF HELICOPTER BLADES [DER GLEICHZEITIGE EINSATZ VON ZWEI TELEMETRIE-ANLAGEN BEI DEHNUNGSMESSUNGEN AN GEGENSINNIG ROTIERENDEN HUBSCHRAUBERBLATTPAAREN]
D. Janssen and R. Lehmann Jan. 1967 41 p refs In GERMAN; ENGLISH summary
(DLR-Mitt.-67-12)

A new method for inflight strain gage measurements is described. The measurements were made on two contrarotating pairs of helicopter rotor blades. The standard method is the transmission of transducer output voltages to an airborn recorder by means of multiple slip rings. A more convenient method uses telemetry to transmit the data to a ground station through two high frequency transmitters fitted directly to the rotors. In this case the additional weight is much reduced. Semiconductor strain gages and dc bridges provide sufficient output voltages. The test equipment is described in detail. The test results are shown in tables. Author

N68-13419# Aeroprojects, Inc., West Chester, Pa.
APPLICATIONS OF ULTRASONIC ENERGY: ULTRASONIC INSTRUMENTATION FOR NUCLEAR APPLICATIONS Bimonthly Progress Report, Aug. 1–Sep. 30, 1967
Oct. 1967 12 p ref
(Contract AT(30-1)-3622)
(NYO-3622-11-11; BMPR-36) CFSTI: HC $3.00/MF $0.65

The molten sodium test cell at Mine Safety Appliances Research Corporation is being modified in preparation for dynamic tests with the ultrasonic incipient boiling detector. Continued experimentation in determining liquid flow rate by measurement of the phase differences in an acoustic wave as detected by receivers located upstream and downstream from the transmitter indicated a reproducible linear relationship. This appears to be a reliable technique since the signals are relatively unaffected by turbulence in the liquid. Author (NSA)

N68-13423# California Univ., San Diego. Marine Physical Lab.
A PHOTOGRAPHIC COMPASS INCLINOMETER
C. G. A. Harrison, A. S. Dunlap, J. D. Mudie, and A. I. Rees 1 Apr. 1967 51 p
(Contract Nonr-2216(05); Grant NSF GP-4003)
(MPL-TM-149; MPL-U-56/64; AD-660875)

An inexpensive device is described which has been designed to provide a method of recording the orientation of deep-sea

sampling devices. A compass and bulls eye level are photographed by a single shot camera. Detailed working procedures are given. Author (TAB)

N68-13430# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
SPATIAL INTENSITY DISTRIBUTION AND COLOR ANALYZER
Roberta L. Urschel and Radames K. H. Gebel Sep. 1967 44 p refs
(ARL-67-0180; AD-661546)

Research leading to new and more advanced imaging devices requires extensive study of large quantities of different semiconductor plates. Very useful in this endeavor is the Spatial Intensity Distribution and Color Analyzer (SIDCA) which, if used properly in connection with a stigmatic spectrograph, reduces the number of spectrographic plates needed for analyzing a target plate from a prohibitively large number to a reasonable one. SIDCA is a specially designed and built opto-electronic scanner using three photomultipliers in connection with suitable filtering, nonlinear amplification techniques, and an analog computer. It can be used in an intensity or spectral analyzing mode. In spectrographic plates, SIDCA can detect information which is not readily perceivable by the human eye. Furthermore, it can map the flaws and spatial uniformity of potential target plates or optical elements by directly scanning them in a transmission or reflection mode. Also, it can show the spatial distribution as a result of diffusion when employing spot doping and can be used for studying spatial effects of emissions from excited semiconductors. It may be used for determining the spatial homogeneity of optical elements such as interference filters, etc. When using appropriate filter-photomultiplier combinations, SIDCA can identify colors in the standardized CIE color triangle; then, the analog computer performs the mathematical operations which result in the presentation of the appropriate locus in the triangle on an oscilloscope, where the parabolic portion of the triangle is obtained by scanning a low leakage verlauf filter or using a suitable, variable monochromator. Author (TAB)

N68-13452# Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria).
SYNCHRONIZED COMPTON SEMICONDUCTOR SPECTROMETER [SUMMIERENDES HALEITER-COMPTON-SPEKTROMETER]
R. Pepelnik, U. Meyer, and H. Hick [1967] 13 p refs In GERMAN
(SGAE-PH-55/1967)

The conventional Compton spectrometer measures electron energy with a semiconducting detector; motions of bound electtons cause spectral line broadening. The energy dependence of this effect is measured for germanium and sicilium from 200 keV to 2,5 MeV. Measurements with a summation Compton spectrometer, that uses two Ge(Li)-detectors, eliminated this broadening effect. Transl. by G.G.

N68-13464# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ELECTRONIC INSTRUMENTATION
D. H. Steinbrecher, K. Biemann, J. I. Glaser, R. E. Lovins, and S. H. Zisk *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 17–24 (See N68-13461 04-23)
(Grant NIH-1-505-FR-07047-01)

In attempting to improve the resolution of the CEC 21-110 mass spectrometer, a study of the factors influencing the resolution has been undertaken. A theoretical study of the spatial distribution of ions in the exit focal plane as a function of the spatial and velocity distributions of ions in the input focal plane has been made with the aid of a computer-simulation of the actual instrument. The theory and computer program will be outlined in this report and some preliminary results will be given. The object of this study is to determine the beam shape in the exit focal plane so that correlation techniques can be used to resolve minute mass differences. Author

N68-13477*# Michigan Univ., Ann Arbor. Infrared and Optical Sensor Lab.
INVESTIGATIONS OF SPECTRUM MATCHING SENSING IN AGRICULTURE, VOLUME 1 Final Report, May 1964–Mar. 1967
Fabian C. Polcyn Nov. 1967 36 p refs
(Grant NsG-715)
(NASA-CR-91522) CFSTI: HC $3.00/MF $0.65 CSCL 14E

Automatic recognition of objects remotely sensed on the basis of their spectral properties, new multispectral instrumentation and data processing techniques were developed. Data with seasonal, diurnal, and altitude variations were taken of selected agricultural areas. Scanner signals were calibrated; angle and altitude effects were studied. It was found that calibrated, simultaneous, multispectral sensing does provide a basis for automatic recognition, and that a broadband multichannel (ultraviolet to infrared) instrument would be desirable to collect additional data. Author

N68-13644# Naval Oceanographic Office, Washington, D. C.
INSTRUMENTS FOR MEASURING TURBULENT PULSATIONS OF CURRENT VELOCITY AND TEMPERATURE AT GREAT DEPTHS [APPARATURA DLYA IZMERENIYA TURBULENTNYKH PUL'SATSIY SKOROSTI TECHENIYA I TEMPERATURY NA BOL'SHIKH GLUBINAKH OKEANA]
A. G. Kolesnikov, N. A. Panteleyev, G. Yu. Aretinskiy, and V. Z. Dykman 1967 15 p refs Transl. into ENGLISH from Metody i Pribory Dlya Issled. Fiz. Protsessov v Okeane (Kiev), v. 36, 1966 p 15–25
(NOO-TRANS-376; AD-661752)

Electronic instruments used for recording turbulent pulsations of current velocity and temperature at great depths are described. Their operation and accuracy are briefly analyzed, illustrating the parts and principles of operation by diagrams. Also the major trends in designing more advanced models are outlined. Author (TAB)

N68-13652# Royal Aircraft Establishment, Farnborough (England).
A MACH NUMBER MONITOR FOR A TRANSONIC WIND TUNNEL
S. Barcroft Jul. 1967 14 p refs
(RAE-TR-67155) CFSTI: HC $3.00/MF $0.65

This report describes the Mach number monitor installed in the 3ft tunnel at R.A.E. Bedford for use in setting and holding constant the test Mach number at transonic speeds. A Wheatstone bridge is employed to compare the ratio of resistance analogues of static pressure and total pressure with a four-digit target ratio. Unbalance is indicated in terms of error in Mach number M. The instrument is accurate to 0.001 M over its useful range of M=0.3 to 1.4 K also provides an electrical output which could be used for automatic control of tunnel speed. Author

N68-13669 Polish Academy of Sciences, Warsaw.
ON THE CHECKING OF INSTRUMENTAL ERRORS OF A ZENITH TELESCOPE [KONTROLA BLEDOW INSTRUMENTALNYCH TELESKOPU ZENITALNEGO]
Jan Bieniewski *In its* Latitude Variations Gravimetry 1967 p 71–75 (See N68-13661 04-30)

A method of determining the instrumental constants by means of observations of meridian transits of stars is described. With the accuracy of $0^s.1$, the computations are simple and quick. Author

N68-13672 Polish Academy of Sciences, Warsaw.
INSTRUMENTAL ERRORS OF THE ZENITH TELESCOPE IN JOZEFOSLAW [BLEDY INSTRUMENTALNE TZ W JOZEFOSLAWIU]

Idzi Gajderowicz *In its* Latitude Variations Gravimetry 1967 p 93–113 refs (See N68-13661 04-30)

An investigation of the telescope's stability is reported. The theoretical analysis of instrumental errors is described. The permissible range of azimuth is calculated from observed values of collimation and inclination. Five methods of determining the errors are discussed. Precise formulas for Döllen's method are developed and the correlation between striding level readings and inclinations of vertical and horizontal axes are investigated. Practical determinations reveal the good stability of the instrument. The investigation also covered the daily variation of the inclinations, and the results are presented in graphical form. Author

N68-13673 Polish Academy of Sciences, Warsaw.
A COMPARISON OF METHODS OF DETERMINING THE VALUE OF THE TURN OF THE MICROMETER SCREW [POROWNANIE METOD WYZNACZANIA KROKU SRUBY MIKROMETRU TELESKOPU ZENITALNEGO]
Kazimterz Schilling *In its* Latitude Variations Gravimetry 1967 p 115–123 refs (See N68-13661 04-30)

The micrometer screw of the zenith telescope was investigated using both the scale pairs and the scale series of stars. The scale pairs were formed with FK 4 stars and with stars from Sollenberger's list of stars observed with the Washington PZT. For the scale series, the stars were chosen from the Yale catalog. A systematic difference was found between the value based on the Sollenberger catalog and that based on FK4 and Yale pairs. This indicates the suitability of Yale star positions for the evaluation of the turn of a micrometer screw. Author

N68-13681# Naval Research Lab., Washington, D. C.
LUMINESCENCE DOSIMETRY
Frank H. Attix, ed. Oak Ridge, Tenn. AEC Apr. 1967 561 p refs Proc. of the Intern. Conf. held at Stanford, Calif., 21–23 Jun. 1965 Sponsored by ONR and Stanford Univ.
(Contract AT(04-3)-115)
(CONF-650637) CFSTI: HC $3.00/MF $0.65

The luminescence dosimetry conference proceedings centered on the basic mechanisms, materials preparation and properties, low dose instrumentation and spurious thermoluminescence, dosimetry applications, and the response to neutrons, beta rays, and heavy charged particles. For individual titles, see N68-13682 through N68-13726.

N68-13683# Wisconsin Univ., Madison. Dept. of Chemistry.
EARLY STUDIES OF THERMOLUMINESCENCE RADIATION DOSIMETRY
Farrington Daniels *In* NRL Luminescence Dosimetry Apr. 1967 p 34–43 refs (See N68-13681 04-14)

A review article is presented on the early research in thermoluminescence dosimetry. Topics discussed are dosimeter construction, early measurements, uniformity of lithium fluoride, aluminum oxide dosimeters, and recent reactivation of thermoluminescent dosimetry research. NSA

N68-13697# Atomic Energy Commission Research Establishment, Riso (Denmark).
THERMOLUMINESCENCE READOUT INSTRUMENT FOR MEASUREMENT OF SMALL DOSES
J. Lippert and V. Mejdahl *In* NRL Luminescence Dosimetry Apr. 1967 p 204–216 refs (See N68-13681 04-14)

A thermoluminescence readout instrument based on modulation of the light emitted by a luminophor during heating has been designed and constructed. After amplification, the alternating signal from a PM tube is rectified by a phase-sensitive detector. By this method an effective reduction of the noise caused by the PM-tube dark current was obtained. The performance of the instrument was tested with LiF (TLD-100) and $CaSO_4$:Mn luminophors. With $CaSO_4$:Mn an exposure of 5 μR of ^{60}Co gamma radiation could be measured with a standard deviation of 10%. The lower limit for LiF was approximately 1 mR. Various properties of the luminophors, including response characteristics, sensitivity to light, and decay of stored energy were investigated. Author

N68-13698# Wisconsin Univ., Madison.
PERSONNEL DOSIMETRY WITH CRYSTALS OF LITHIUM FLUORIDE
N. Suntharalingam, D. W. Zimmerman, and G. N. Kenney *In* NRL Luminescence Dosimetry Apr. 1967 p 217–226 refs (See N68-13681 04-14)

An instrument was constructed to measure the thermoluminescence from single crystals of LiF exposed to radiation levels of 10 mR to 1000 R. The reader is basically similar to those described earlier but uses a cooled PM tube and is modified to use about 20-mg single crystals with nitrogen gas flow immediately before reading. It provides both a glow curve and a value of integrated light output for each crystal. A ^{90}Sr–^{90}Y radiation source is built into the reader to permit the calibration of each crystal immediately after reading. Lithium fluoride single crystals in Lucite capsules were attached to film-badge holders and given known test exposures from X- and γ-ray sources. The LiF and film-badge results are compared to the test exposures. The energy response of LiF in these capsules is also discussed. Author (NSA)

N68-13703# Stanford Univ., Calif.
PROBLEMS OF READER DESIGN AND MEASUREMENT ERROR IN LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETRY
C. J. Karzmark, J. F. Fowler (Hammersmith Hosp.), and J. T. White (St. Bartholomew's Hosp.) *In* NRL Luminescence Dosimetry Apr. 1967 p 265–283 refs Repr. from Intern. J. Appl. Radiation and Isotopes, v. 17, no. 161, 1966 (See N68-13681 04-14)

A number of reader design and operation problems, and their relevance to measurement error, are discussed. These include: effects relating to the precision of dispensing the powder, a geometrical analysis pertinent to the positioning of powder in the readout tray, infrared and tribothermoluminescence contributions and their relation to heating and readout-cycle termination, powder reuse, photomultiplier fatigue and related considerations, some cautions to observe in using light standards for sensitivity checks, and the presence of significant fading in certain LiF phosphors if readout is delayed more than a day or two after exposure. Operational problems in using readers are best resolved with the aid of glow curves. Systems that permit simultaneous recording of the glow curve, its integral, and the tray temperature are more amenable to an analytical solution of readout problems than those which do not provide this facility. Author

N68-13704# Tokyo Shibaura Electric Co., Ltd., (Japan). Central Research Lab.
RECENT IMPROVEMENTS IN RADIOPHOTOLUMINESCENT DOSIMETRY
Ryosuke Yokota and Saburo Nakajima *In* NRL Luminescence Dosimetry Apr. 1967 p 284–299 refs (See N68-13681 04-14)

Low-Z silver-activated phosphate glass with higher sensitivity and better durability to weathering has been developed. Buildup of radiophotoluminescence (RPL) with $AgPO_3$ content has been studied, and low-Z glass with rapid buildup and negligible fading has been developed. The remarkable uniformity of the sensitivity of the glass is established. It is found that the figure of merit of dosimeter glass depends not only on the predose RPL level but also on sensitivity in the case of zero-detecting methods. To reduce measurement errors, the mechanical accuracy of the glass positioning has been improved, and an optical system that has lower sensitivity to dirt on the glass and its holder has been developed. Consequently, reproducibility and sensitivity has been considerably improved. Convenient badge cases suitable for use with a γ-ray-energy range from 25 keV to 3 MeV have been developed.

The application of glass dosimeters for personnel monitoring is discussed in comparison with other dosimeters. Author

N68-13705# Karlsruhe Nuclear Research Center (West Germany). Radiation Measuring Service.

PHOSPHATE GLASSES AS ROUTINE PERSONNEL DOSIMETERS

R. Maushart and E. Piesch *In* NRL Luminescence Dosimetry Apr. 1967 p 300–307 refs (See N68-13681 04-14)

Phosphate glasses of the Yokota type which have a lower γ-ray-exposure limit of about 40 mR have been in routine use as personnel dosimeters for several years. As a result of these experiences, two dosimeter systems have been developed which are now in large scale use. One is a spherical casing containing one glass brick for direction- and energy-independent measurements of quantum energies above 45 keV. The other is a combination for measurements in the very-low-energy region designed primarily for the surveillance of radiation to personnel working with plutonium. Moreover, some dosimeter systems have been tested and used that allow correct dose measurements in mixed radiation fields. Because they are very small, most of the glass dosimeters can be worn at the wrist as well as on the body itself. Author

N68-13706# Controls for Radiation, Inc., Cambridge, Mass.

LITHIUM FLUORIDE–TEFLON THERMOLUMINESCENCE DOSIMETERS

Bengt E. Bjaerngard, Richard C. McCall, and Irving A. Berstein *In* NRL Luminescence Dosimetry Apr. 1967 p 308–316 refs (See N68-13681 04-14)

When thermoluminescent LiF powder is incorporated into a Teflon matrix, dosimeters can be fabricated which combine ease of handling and readout with reproducible sensitivity. The properties of such LiF-Teflon dosimeters were investigated. Thin disks, 12.5 mm in diameter and 0.13 to 0.5 mm in thickness, containing 25% LiF, and rods, 1 mm in diameter and 6 mm in length, containing 8% LiF were studied. Fabrication of other shapes or dosimeters, as larger and smaller disks and as longer and shorter lengths of rods, is possible. NSA

N68-13707# Total Kommanditgesellschaft Foerstner und Co., Ladenburg (Germany).

POSSIBILITIES IN RADIOPHOTOLUMINESCENCE DOSIMETRY AND A RECENT DEVELOPMENT WITH PARTICULAR ATTENTION TO DOSIMETER AND READER TECHNIQUES

W. Buttler *In* NRL Luminescence Dosimetry Apr. 1967 p 317–321 refs (See N68-13681 04-14)

An evaluation of the absorbed dose with the use of pulsed-light excitation of a phosphate glass previously exposed to ionizing radiation is described. This technique is based on the electronic time integration of fluorescence induced by a single flash of a normal flashlamp. Furthermore, an airtight and moistureproof dosimeter with an identity tag is shown. A strong permanent magnet with specially shaped pole pieces is used to dismantle and assemble the dosimeter for evaluation. Author (NSA)

N68-13709# Atomic Weapons Research Establishment, Aldermaston (England).

SOME APPLICATIONS OF LOW-DOSE THERMOLUMINESCENCE MEASUREMENTS WITH CALCIUM FLUORIDE

J. R. Harvey *In* NRL Luminescence Dosimetry Apr. 1967 p 331–339 (See N68-13681 04-14)

An instrument is described that will read commercially available dosimeters that utilize the thermoluminescence of natural calcium fluoride. The most sensitive range is 50 mR. The dosimeters, which are rate independent and relatively insensitive to fast neutrons, have found application in low-level dosimetric studies. A technique is described whereby the light sensitivity of the dosimeter can be used to gain a measure of the total dose to which it has been subjected during its life. Author (NSA)

N68-13710# European Atomic Energy Community, Ispra (Italy).

RECENT APPLICATIONS OF THERMOLUMINESCENCE DOSIMETRY

M. Oberhofer (Joint Nucl. Res. Center), N. Haring, and K. Luchner (Tech. Hochschule Munchen) *In* NRL Luminescence Dosimetry Apr. 1967 p 340–348 refs (See N68-13681 04-14)

For several years at the Laboratorium für Technische Physik of the Technische Hochschule München, CaF_2:Mn powder has been used for dosimetric studies. Dosimeters were developed which were used for measuring doses and dose rates in animals that had ingested radiostrontium. The measuring procedure is described, and results are presented. The CaF_2:Mn powder also was applied behind thin foils containing ^6Li for measuring energy-independent neutron-dose equivalents at a phantom. Results obtained are discussed together with further results of investigations in fast-neutron dosimetry. That there are applications of thermoluminescence outside the field of biology and medicine is best demonstrated by the determination of the average β energy per fission of ^{235}U with the help of a special CaF_2:Mn dosimeter. At Euratom's research center at Ispra, CaF_2:Mn and LiF powders are to be used in the Dosimetry Branch of the Health Physics Division for routine personnel monitoring. Preparations have been made for measuring finger-tip doses with luminescence powder. Investigations are under way to clarify whether luminescence powders can be applied successfully to contamination control and used for surface-dose-rate measurements. Author (NSA)

N68-13713# Sloan-Kettering Inst. for Cancer Research, New York.

DIRECT INTERCOMPARISON OF ABSORBED DOSE BY THERMOLUMINESCENT DOSIMETRY

A. Pinkerton, J. G. Holt (Mem. Hosp.), J. S. Laughlin, and P. R. Almond (Anderson Hosp.) *In* NRL Luminescence Dosimetry Apr. 1967 p 363–371 refs (See N68-13681 04-14)

(Contract AT(30-1)-3510; Grants PHS-CA-06294; PHS-CA-5099)

In connection with the use of high-energy X-rays and electrons for radiation therapy and radiobiology, quantitative comparability of absorbed dose between different installations is necessary. Although ionization methods have been successfully used for such intercomparisons, the use of LiF appears to have certain advantages. The property of nearly permanent radiation memory makes the use of suitably designed LiF dosimeters feasible for mailing and subsequent reading and/or irradiation. Their compactness permits localization of the dose essentially at a point in a medium. The solid nature of this detector makes it preferable to gaseous detectors, in which the polarization effect is absent, thus giving rise to an undesirable energy dependence in the relation of detector response to tissue dose for high-energy electrons. Dosimeters of ^7Li-enriched phosphor have been prepared from separate supplies at both the Memorial Hospital and Sloan–Kettering Cancer Center (Memorial–Sloan–Kettering) and the M. D. Anderson Hospital and Tumor Institute (M. D. Anderson) then interchanged for irradiation, and finally returned to the parent laboratories for dose determination. Irradiations were carried out at doses between 50 and 200 rads with 10- and 15-MeV betatron electrons and ^{60}Co γ rays under similar conditions in either water or polystyrene phantoms. The results of a number of such exchanges, expressed as ratios of thermoluminescent response (i.e., M. D. Anderson/Memorial–Sloan–Kettering) are presented. Measurements also have been made on control samples that had been irradiated prior to the transfer shipments. Long-term reproducibility of measurements is between 1% and 2%. Within this uncertainty, good agreement in the determination of absorbed dose at the two institutions is indicated. Author (NSA)

N68-13720# Battelle-Northwest, Richland, Wash. Radiation Protection Dept.

THERMOLUMINESCENCE DOSIMETRY STUDIES AT HANFORD

G. W. R. Endres *In* NRL Luminescence Dosimetry Apr. 1967 p 435–443 ref (See N68-13681 04-14)

Several different batches of phosphor were used to study the energy and dose response, storage properties, and parameters of the readout system. The neutron-dosimeter system described requires two capsules of LiF, one filled with the phosphor alone for measurement of γ-ray exposure and the other filled with the phosphor plus alcohol (or other hydrogenous material) for measurement of the γ-ray plus neutron exposure. Results of the two measurements are subtracted to obtain the neutron exposure. Extensive tests of the characteristics of the dosimeter for γ-rays only were conducted. The response vs. γ-ray exposure was quite linear over the range of values studied. The minimum detectable γ-ray exposure was 10 mR with 50 mg of phosphor. Low-energy ($\approx$20 keV) X-ray exposures show that the response per roentgen increases to about 35% above that at high energy ($\approx$1 MeV). Preliminary measurements of the mixed n-γ field from a PuBe source with the use of alcohol-filled vs. dry LiF dosimeters confirmed that fast neutrons could be detected through proton-recoil production in the alcohol. Author

N68-13722# Brookhaven National Lab., Upton, N. Y. Health Physics Div.

THERMOLUMINESCENT NEUTRON-DOSIMETRY SYSTEM

C. Distenfeld, W. Bishop, and D. Colvett *In* NRL Luminescence Dosimetry Apr. 1967 p 457–466 refs (See N68-13681 04-14)

A neutron dosimetric system has been developed by using LiF phosphors within a Bonner sphere. A 12-in.-diameter polyethylene sphere modifies the neutron response characteristics of a lithium-bearing material to reasonably resemble the dose-equivalent response characteristics of neutrons in tissue. This fortunate response extends from thermal energies to approximately 20 MeV. A necessary second characteristic for a useful neutron dosimeter is for it to be able to differentiate between neutrons and γ-rays. The large difference in neutron-absorption characteristics between ^{6}LiF and ^{7}LiF permits evaluation of the neutron and γ doses for mixed fields. This evaluation depends on a detailed knowledge of the neutron and γ response characteristics of the two isotopic phosphors. The gamma responses are very similar, except for a minor mass correction, allowing precise γ-ray subtraction and thereby unmasking the neutron contribution. Neutron response was evaluated by using a positive-ion Van de Graaff generator to produce monoenergetic neutrons. Sensitivity to plutonium–beryllium source neutrons was determined by simultaneous exposure of TLD-600 and TLD-700 phosphors within a 12-in.-diameter sphere. Author

N68-13723# Naval Radiological Defense Lab., San Francisco, Calif.

SOME RECENT STUDIES IN NEUTRON GLASS DOSIMETRY

K. H. Becker and J. W. N. Tuyn (Reactor Instituut) *In* NRL Luminescence Dosimetry Apr. 1967 p 467–481 refs (See N68-13681 04-14)

Recent studies concerning the thermal- and fast-neutron sensitivity of commercial and experimental radiophotoluminescent silver-activated dosimeter glasses are summarized. The thermal-neutron sensitivities of several experimental glasses were calculated and found to be in agreement with $\pm$10% of the experimental values. The effects of glass thickness and ^{10}B and/or ^{6}Li enrichment also were calculated. The different possibilities of increasing the fast-neutron sensitivity of glasses are briefly discussed, and some experimental results are presented (fission and americium/beryllium neutron sensitivity of bare glasses and glasses between moderator layers of different thickness and response of pairs of tin- or cadmium-shielded glasses to different neutron energies). These methods may be of some practical interest for the detection of intermediate- and fast-neutron exposures in personnel dosimetry. For fast-neutron dosimetry, however, the technique of fission-fragment registration in glasses seems to be much more accurate and sensitive. Some results on the visualization of the fission fragments by etching of the glass surface with different solutions and the sensitivity of different glass-fission-coil combinations (natural uranium and thorium, depleted and enriched uranium, and ^{237}Np) to different neutron sources (thermal to 14 MeV) are described. Several aspects of application of these methods in routine dosimetry are discussed: a method for automated counting of the etch pits and a brief description of a proposed multiglass personnel dosimeter for X- and γ-rays, thermal and fast neutrons, and β rays. Author (NSA)

N68-13724# Argonne National Lab., Ill. Radiological Physics Div.

LITHIUM FLUORIDE THERMOLUMINESCENT DOSIMETRY FOR BETA RAYS

Jacob Kastner, Ramesh Hukkoo, and B. G. Oltman *In* NRL Luminescence Dosimetry Apr. 1967 p 482–489 refs Presented at the Radiation Res. Soc. Meeting, Philadelphia, May 1965 (See N68-13681 04-14)

The possibility of using LiF thermoluminescence for in vivo or in vitro direct-dose measurements in tiny body cavities (e.g., bone marrow) suggested investigation of the response of LiF to β radiation. Several β-ray sources were made in the form of gelatin or polyester-resin molds. The emitters consisted from the known concentration in each case. Water around the crystal during and after irradiation did not affect the energy storage. As expected, the light output per unit LiF weight and per unit dose was essentially the same for ^{204}Tl and ^{90}Sr as for ^{60}Co, but it dropped markedly for the lower energy β-ray emitters. However, even for tritium, this form of dosimetry is quite feasible provided careful precalibration is carried out with a LiF sample of the specific batch to be employed. Applications to the dosimetry of β-ray applicators are described. Author (NSA)

N68-13872# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

DOUBLE FOCUSING MAGNETIC α SPECTROMETER [MAGNITNYI AL'FA-SPEKTROGRAF S DVOINOI FOKUSIROVKOI]

N. A. Golovkov, K. Ya. Gromov, Yu. N. Denisov et al 1967 28 p refs In RUSSIAN

(JINR-P13-3340)

A double-focusing magnetic α spectrometer was designed and constructed. The α spectrometer is described and its installation for measurement of magnetic fields is reported. The shape of the magnetic fields of the spectrometer is determined and its focusing properties are measured. The methods used for the calibration of the spectrograph are discussed. NSA

N68-13874# Union Carbide Nuclear Co., Oak Ridge, Tenn. Oak Ridge Gaseous Diffusion Plant.

DENSITY OF VOLATILE CORROSIVE LIQUIDS: METHOD AND EQUIPMENT

W. D. Hedge [1967] 11 p

(Contract W-7405-ENG-26)

(K-L-6163; CONF-671012-1)

Equipment and techniques for determining the density of corrosive liquids at temperatures above 64°C are presented. The pycnometers, used with UF_6 at 65, 70, 80, and 90°C in this experiment, apply equally well to nonvolatile and inert liquids. Standard deviation of a single ratio measurement is $\pm$0.001 g/cc while the accuracy of the method is -0.0001 ± 0.0004 g/cc as estimated from mass spectrometrically measured isotopic abundances and known molar volumes. NSA

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-12809* Pyrogenics, Inc., Woodside, N. Y.
STUDY OF THE USE OF VAPOR AND VACUUM TECHNIQUES FOR THE DEVELOPMENT OF HIGH STRENGTH FILAMENTARY MATERIALS Summary Technical Report, May 22, 1966–May 21, 1967
William A. Robba 21 May 1967 37 p refs
(Contract NASw-1414)
(NASA-CR-91279) CFSTI: $3.00 CSCL 13H

Pyrolytic graphite thin films were successfully deposited on liquid metals at temperatures ranging from 1100–2100°C. The optimum deposition temperature for the liquid metal used was 1600° to 1800°C. Filaments in the 2–10μ thickness range as produced in deposition times under two minutes. Several methods of cutting the filaments were investigated, but no satisfactory technique has been developed. Tensile strengths as high as 238,000 psi were measured with Young's Modulus in the 40 to 60 million psi range. The average filament strength was 100,000 psi, but the scatter in the data indicates that the true strength is probably about 200,000 psi. Author

N68-12853* Grumman Aircraft Engineering Corp., Bethpage, N. Y.
STUDY ON DEVELOPMENT OF TECHNIQUES FOR FABRICATING ADVANCED HIGH STRENGTH ALLOYS; CRYOGENIC QUENCHING PROCESS EVALUATION Final Report, 10 May–10 Dec. 1966
E. Dullberg and M. Meyer Dec. 1966 53 p ref
(Contract NAS8-20335)
(NASA-CR-91344) CFSTI: $3.00 CSCL 13H

The distortion-free aspect of a cryogenic quenching process was evaluated on heat-treatable aluminum and titanium alloys, and strength levels for light gage aerospace components were determined. The work was divided into the following tasks: (1) proving the distortion-free aspect of liquid nitrogen quenching vs. water quenching on aluminum and titanium alloys of various gages and shapes, (2) testing and documenting mechanical properties and stress corrosion data of aluminum alloys 2014-T6, 2219-T6, and 7039-T63, and (3) metallographic evaluation of the above alloys. Author

N68-12890*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EQUIPMENT AND PROCEDURES FOR GLASS-BEAD PEENING TITANIUM-ALLOY TANKS
Thomas T. Bales, Charles R. Manning, Jr., and W. Barry Lisagor Washington Jan 1968 32 p refs
(NASA-TN-D-4288) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Glass-bead peening equipment which utilizes programmed motions has been developed and used to peen uniformly the inner surface of 26 titanium alloy spacecraft tanks for the alleviation of stress corrosion resulting from exposure to nitrogen tetroxide. The tanks which were peened varied from 20 inches to 14 feet (0.5 to 4.2 m) in length and from 12.5 to 51 inches (0.3 to 1.3 m) in diameter. The function of each component of the developed equipment and the procedures used for peening are described herein. Glass-bead peening parameters have been investigated and parameters were established which produced a compressive stress of approximately 100 ksi on the peened surface of titanium test strips. The effect of glass-bead peening on the mechanical properties of the titanium Ti–6Al–4V alloy was determined from tests conducted by using peened and unpeened standard tensile and V-notch specimens as well as from results of a burst test of a peened tank. A slight reduction in the yield and notch properties of the material was noted after peening; the ultimate tensile strength, elongation, and modulus of the material, however, were found to be unaffected. Author

N68-12896# National Engineering Lab., Glasgow (Scotland).
A PRELIMINARY STUDY OF THE CO-EXTRUSION OF DISSIMILAR METALS
E. Whitfield Jan. 1967 34 p refs
(NEL-265)

A preliminary investigation has been made to ascertain the factors which govern the extrusion of rod, tube and can from combinations of dissimilar metals. The results obtained showed that the flow of metal during co-extrusion was dependent on the relative extrudabilities, disposition and dimensions of the dissimilar metals in the original billet, and on the die geometry. The co-extrusion of rod appeared to be limited to metals of fairly similar extrusion characteristics and the loss of useful product due to dissimilar flow appeared to be less if the billet was made such that the material of higher strength was wholly enclosed by that of the lower strength. No metallurgical bonding was achieved under the condition of test at room temperature. Author

N68-12900* Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
BONDING LARGE AREA SILICON WAFERS Quarterly Report
[1967] 19 p Prepared for JPL
(Contracts NAS7-100; JPL-952022)
(NASA-CR-91446; QR-1) CFSTI: $3.00 CSCL 13H

Bonding large area silicon single crystals to heat sinks is discussed. Both gold–silicon alloy and aluminum–germanium alloy solder systems received preliminary evaluations. Computer programs are being written for a study of stresses set up between bonded materials due to differences in their thermal expansion coefficients, and for a study of heat flow from dissipating junctions to the package heat sink. A thermal conductometer has been selected and ordered to enable the thermal conductivities of solder alloys to be determined as a function of their composition. Author

N68-13105* Sea-Space Systems, Inc., Torrance, Calif.
PROJECT ULTRA-ECHO Final Report
May 1967 75 p
(Contract NAS5-3964)
(NASA-CR-91373) CFSTI: $3.00 CSCL 13H

Many improvements on the balloon satellites of the Echo class can be realized by the development of inflatable modules, 1 inch by 6 feet long, of ultra-thin polyethylene film which serves as carrier for a 1/8×1/8 inch metal mesh of 1- or 2-mil wires, rigidly joined at all intersections. These tubular modules serve as the structural members of a space truss which can be of any configuration, and is erected in space after orbit is achieved, by inflating the modules so that each becomes a pressure-stiffened cylinder. Inflation strains the metal mesh into its plastic region, and the permanent set in the metal is retained indefinitely after the pressurizing gas is lost. The film is melted by exposure to the sun and withdraws onto the metal; thereafter the extended truss presents a large surface as a conductor to reflect electromagnetic waves, but a small surface to drag and radiation forces which degrade the orbit. Studies of the joining problem settled on resistance welding as the only acceptable method, and materials studies settled on 347 stainless steel. 1×6 inch modules were hand made, and the welding process was mechanized, step wise, culminating in an automatic winding and welding machine which will make 8 feet of tube in an hour. Author

N68-13219* Boeing Co., Seattle, Wash. Aerospace Group.
STUDY OF DISSIMILAR METAL JOINING BY SOLID STATE WELDING Final Report
C. H. Crane, D. T. Lovell, and H. A. Johnson Nov. 1967 81 p
(Contract NAS8-20156)
(NASA-CR-91435) CFSTI: $3.00 CSCL 13H

Dissimilar metal tubular transition joints having diameters of 0.5, 2.0, 4.0, and 8.0-inches were fabricated by diffusion welding from the following alloy combinations: 2219 aluminum alloy to AISI Type 321 stainless steel, 2219 aluminum alloy Ti–5Al–2.5Sn titanium alloy, and AISI Type 321 stainless steel to Ti–8Al–1Mo–1V titanium alloy. The joints were tested at room temperature and −320°F using thermal shock, random and sinusoidal vibration, pressure cycling, and burst tests for structural reliability as well as to obtain joint design data. Helium leak testing and metallurgical examinations were also used to evaluate joint characteristics. Discussions are included on tooling and processing techniques applicable to potential production of diffusion welded tubular components. Also, solid state joining results and potential aerospace applications are included for other composite forms. Author

N68-13275 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
THE INFLUENCE OF LONG-TIME HEATING ON NONHIGH-TEMPERATURE METAL ADHESIVES AND METAL-BONDED JOINTS [DER EINFLUSS LANGER WAERMEEINWIRKUNG AUF NICHTWAERMEBESTAENDIGE METALLKLEBSTOFFE UND KLEBVERBINDUNGEN]
W. Althof Jul. 1967 44 p *refs* In GERMAN; ENGLISH summary
(DLR-FB-67-49)

The effect of temperatures from 80° to 150°C on the strength of metal joints bonded with adhesives designed for normal temperatures was investigated after exposures up to 1000 hours. In addition, the mechanical and thermal properties of the adhesives were studied in torsion-pendulum tests in order to determine the causes for the changes in bonding strength. K.W.

N68-13299* Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
DEVELOPMENT OF A SYSTEM FOR BIAXIAL PRESTRESSING BRITTLE MATERIAL, VOLUME 2 Quarterly Report, 1 Sep.–30 Nov. 1967
L. B. Greszczuk, R. J. Miller, and W. S. Netter 8 Dec. 1967 73 p *refs*
(Contract NAS8-21083)
(NASA-CR-91470; DAC-60806, V. 2; QR-2) CFSTI: $3.00 CSCL 13H

Experimental studies were conducted on strengthening of chemically bonded zirconia with short tungsten fibers as well as silicon carbide and sapphire whiskers. Using these materials, flexure specimens were prepared and tested at room temperature and at 2000°F. Based on these tests, silicon carbide whiskers in the amount of 7.4 weight percent were selected as the reinforcing material for strengthening of zirconia. For more complete characterization of the SiC-whisker-strengthened ceramic, additional specimens were prepared for obtaining flexure strength and modulus, shear strength, coefficients of thermal expansion and tensile strength and modulus, all at room and elevated temperatures. Test results are reported and a set of recommendations is given for additional studies on fiber-strengthened ceramics. An analysis on biaxially prestressed ceramic subjected to internal prestress, elevated temperature, and external loading was conducted. Numerical results on factors affecting the internal stresses in constituents are given. Author

N68-13300# Western Electric Co., Inc., Chicago, Ill.
AN OPERATING EVALUATION OF VARIOUS EIGHT-INCH EXTRUDER SCREWS USING AN INFRARED THERMOMETER
R. V. de Boo and W. B. Beck [1967] 29 p *refs* Prepared jointly with Du Pont De Nemours and Co. Presented at the 16th Ann. Symp. on Wire and Cable, Atlantic City, 29 Nov.–1 Dec. 1967 Sponsored by Army
(AD-661401)

Several different screw designs were performance evaluated in 8-inch diameter cable jacketing extruders. The objective was to compare the performance of these screw designs in terms of output capacity and quality while extruding low density polyethylene. Instrumentation for these evaluations included infrared thermometry as a means of monitoring temperature fluctuations of the extruded cable jackets. Results of these evaluations confirmed the output performance of the compression relief design. Performance of both the long metering and slotted-ring screw designs was also significant in terms of uniformity and capacity. In addition, this study demonstrated the suitability of infrared thermometry for operational evaluation of an extruder system. Author (TAB)

N68-13317 College of Aeronautics, Cranfield (England). Dept. of Materials.
THE EFFECT OF PLASTIC ANISOTROPY ON FLANGE WRINKLING BEHAVIOUR DURING SHEET METAL FORMING
H. Naziri and R. Pearce [1967] 27 p *refs*
(COA-Note-Mat.-12)

During the drawing of sheet metal between a die and a blankholder, compressive hoop-stresses are developed with attempt to thicken or wrinkle the flange. Previous work on this behaviour has ignored any effects due to normal or planar plastic anisotropy. In this paper it is shown that the blankholder pressure necessary to suppress wrinkling increases with decreasing normal anisotropy (r) and increases with increasing planar anisotropy (Δr). The approximate plane strain conditions ($d\epsilon_z=0$) operating in the flange can be simulated by an edge-notched tensile specimen and this simulation demonstrates the effect of texture hardening and softening upon flange wrinkling behaviour. The results obtained can be interpreted qualitatively by the use of anisotropic plasticity theory. The speed of drawing also affects wrinkling, in general, the number of wrinkles decreases with increasing drawing speed. Author

N68-13410 Tokyo Univ. (Japan).
NON-STEADY CHARACTERISTICS OF HYDRODYNAMIC TRANSMISSION
Tomo-o Ishihara, Richard I. Emori, and Haruhiko Saito 10 Jul. 1967 51 p *refs* *Its* Rept. of the Inst. of Ind. Sci., V. 18, No. 1; Serial No. 115
CFSTI: $3.00

The purpose of the study is to establish the equation of non-steady motion for the hydrodynamic drive and to obtain its speed changing characteristics and vibration transmissibility. Also a simulation model as a certain combination of masses, spring and dashpots is to be proposed for easier analysis of a system which includes a hydrodynamic drive. In this report the equation of non-steady motion of the working fluid was developed. With two other equations for input and output members, it forms the simultaneous differential equations whose variables are input speed, output speed and flow velocity in the hydrodynamic circuit. The equations are non-linear and a general analytical solution may not be easily obtained. For relatively slow speed changing phenomena, the equations were solved numerically. For vibrations around a steady state operating point, the equations were linearized and Laplace-transformed to obtain various transfer functions. Author

N68-13432* Mechanical Technology, Inc., Latham, N. Y.
JOURNAL BEARING DYNAMIC RESPONSE Technical Report, 1966–1967

Stan B. Malanoski and Denis Dougherty Feb. 1967 62 p refs
Sponsored in part by NASA
(Contract Nonr-3730(00))
(NASA-CR-91499; MTI-67TR-88; AD-661823) CFSTI: $3.00 CSCL 13I

The response of a rigid-bearing, simple-rotor system subjected to an impact load applied to the rotor or pedestal support is analyzed. The problem assumes the bearing-rotor system to be initially under steady-state pressure conditions before the impact load is applied. The solution is realized upon obtaining the transfer function between the applied load and the dynamic displacement of the system and converting this function to the time domain. This inverse transform can be reduced to a line integral along the imaginary axis when considering stable systems. The linearized ph solution represents the model for the finite, plain journal bearing, and the linearized p solution represents the model for the finite, spiral-grooved journal bearing. These solutions are used to generate the transfer function, or admittance matrix. The perturbed equations of motion are derived for shock loads applied to either the pedestal or the rotor. The shock loadings are characterized by either impulse, unit step, or finite duration pulse forcing functions. Some frequency response and transient response results showing the effect of L/D, epsilon, lambda and mass parameter, are presented and discussed for the plain journal and spiral-grooved journal bearings. Author (TAB)

N68-13433 Joint Publications Research Service, Washington, D. C.
THE PROPULSOR OF THE PUMP TYPE FOR SHIPS
G. I. Zotikov 14 Dec. 1967 19 p Transl. into ENGLISH from Sudostroyeniye (Moscow), no. 7, 1967 p 5–9
(JPRS-43721) CFSTI: $3.00

Means for determining basic characteristics of pump-type propulsors (or propellers) for ships are presented, and a comparison with screw propellers indicates that pump-type components may have performance advantages. A propulsor is essentially a high-speed axial pump, consisting of inlet and outlet elements and an impeller to impart the necessary energy to the mass of water flowing through the propulsor. Efficiency of the propulsor is tabulated for various flow accelerations, and detailed equations are presented for determining its characteristics. M.W.R.

N68-13547* SKF Industries, Inc., King of Prussia, Pa. Research Lab.
SUPERSONIC TRANSPORT LUBRICATION SYSTEM INVESTIGATION Semiannual Report
C. G. Hingley, H. E. Southerling, and L. B. Sibley 20 May 1965 215 p refs
(Contract NAS3-6267)
(NASA-CR-54311; AL65T038; SAR-1) CFSTI: $3.00 CSCL 13I

Ball bearings and bellows face seals for use on Mach 3 aircraft gas turbine engine mainshafts, and suitable test rigs to simulate engine operating conditions, have been designed and manufactured. The initial phases of a development program are underway to determine the most suitable combination of presently available materials and lubricants to permit operation of these bearings and seals under typical engine load and speed conditions at the highest possible ambient temperature above 600°F with the seals exposed to 1200°F air and a pressure differential of 100 psi. Tests will be conducted primarily using a nitrogen-blanketed bearing chamber and lubricant system. Test lubricants have been selected for their potential performance under two different application techniques, namely, jet lubrication of the bearings with circulating oil, and once-through lubrication in the form of oil mist. Author

N68-13548*# Solar, San Diego, Calif. Research Labs.
EVALUATION OF THERMAL TREATMENTS FOR NICKEL-BASE INCONEL 718 ALLOY IN BELLOWS AND GIMBAL APPLICATIONS Final Report, Aug. 1965–May 1967
Paul J. Valdez Jul. 1967 173 p refs
(Contract NAS8-11282)
(NASA-CR-61412; SO-6-1616-7; RDR-1460-1) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An investigation has been conducted to establish a thermal treatment for the Inconel 718 alloy for use in bellows and gimbal structures. Because of the likelihood that the nickel-base alloy would be welded in the fully heat-treated condition, variations in thermal treatments and the relationship of the thermal treatments to heat-affected zone cracking and strength properties were studied. The scope of the program was enlarged to determine the effect of cold work and subsequent variations in aging treatments on strength properties. In addition, the effects of time-temperature variations on crack susceptibility, strength, and fatigue properties were also determined. Author

N68-13637*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FRICTION, WEAR, AND THE INFLUENCE OF SURFACES
Edmond E. Bisson Washington 1967 38 p refs Presented at Am. Soc. of Tool and Mfg. Engr. Symp. on Surface Integrity, Pittsburgh, 24–25 Jan. 1968
(NASA-TM-X-52380) CFSTI: HC $3.00/MF $0.65 CSCL 13H

This paper explores how friction and wear are influenced by the surface state. A review is made of the fundamental mechanisms involved in both friction and wear. The adhesion theory of friction is discussed, and the important parameters are pointed out. The strong influence of surface contaminants on the friction process is explored in some detail. The various wear processes (adhesive, abrasive, corrosive, and fatigue) are enumerated and two of them are explored. The influence of crystal structure on friction and wear is discussed, and comparisons are made between the hexagonal and cubic structures as well as differences between single crystals and polycrystal-line materials. Finally, the resistance to wear, as influenced by hardness, is discussed. The three principal ways of increasing hardness as treated are alloying, quenching and tempering, and work hardening. Author

N68-13659*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, 15 Apr.–15 Jul. 1967
R. W. Harrison, ed. 15 Jul. 1967 34 p refs
(Contract NAS3-6474)
(NASA-CR-72336; QPR-9) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The fabrication of all loop components with the exception of the valves and nine-stage turbine simulator was completed. The lithium has been distilled and analyzed. The post test evaluation of the preliminary capsule tests of weld specimens of ASTAR 811 and ASTAR 811CN alloys was completed. The capsule tests have been modified to include the evaluation of ASTAR 811C alloy. A failure mode effects analysis report for Corrosion Loop I (T-111) is in preparation. Author

N68-13738# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
BIMETALLIC CASTINGS
A. V. Lakedemonskiy 17 Apr. 1967 149 p Transl. into ENGLISH from the book "Bimetallicheskiye" Ukrania, 1964 p 3–5, 15–123
(FTD-HT-67-85; AD-661440)

The book examines the theoretical bases of the process of producing bimetallic castings, shows the role of wetting in the formation of bimetallic compounds, proposes a mechanism for the formation of a bond between the metals in a bimetallic casting, gives an analysis of the process of the formation of an intermediate zone and shows the effect of this zone on the strength of the bimetallic bond. The book describes both Soviet and foreign experience in the production of bimetallic castings from aluminum, copper, lead and iron alloys. Author (TAB)

N68-13745# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
HIGH-PURITY SHAPE CASTING WITH AN ELECTRON-BEAM FURNANCE
C. W. Dean and R. E. McDonald Oct. 1967 19 p
(Contract W-7405-ENG-26)
(ORNL-TM-1935) CFSTI: HC $3.00/MF $0.65

A casting technique was developed for use with the electron-beam furnace that permitted a molten charge of high-purity metal to be drop-cast into a cylindrical or rectangular chill mold. Subsequent fabrication was easier and less expensive than previous methods because of the more desirable ingot shapes. In addition, a higher material yield was realized. This drop-casting technique and melting equipment have been used to cast fabricable shapes of Ti, Zr, Nb, V, Ta, W, Mo, and their alloys. Author (NSA)

N68-13801 Academy of Sciences (USSR), Moscow.
INVESTIGATIONS OF THE CHANGES IN THE ZONES OF COLLISION BY EXPLOSIVE JOINING OF METALS
A. Deribas, F. Matveenkov, T. Sobolenko, and T. Teslenko 1967 5 p refs Presented at the Symp. on High Dyn. Pressure, 11–15 Sep. 1967

Microstructure and X-ray analyses of the mixture zones of explosive by joint metals established a fluctuating chemical composition for this zone; percentage fusion of one metal in the other could change from 0 to 100% and was not related to the mutual solubility of welded metals. Sometimes the zone of mixture emerged as one or several combinations with constant compositions. Steel and titanium fusion showed a predominantly 60% Fe+40% titanium combination with a white intermetallic line of FeTi. X-ray diffraction patterns for the mixture zone of Fe +Zr found the lines of the intermetallic combination Fe_2Zr besides lines for Fe and Zr. Similar line formations were disclosed by shock depressed Pb and Cu power mixtures; it was concluded that a new combination of intermetallic Pb + Cu was obtained by the shock compression method. G.G.

N68-13818*# Franklin Inst., Philadelphia, Pa. Research Labs.
AN ANALYSIS OF THE SIDE-LEAKAGE EFFECT IN HIGH-SPEED GAS LUBRICATED SLIDER AND PARTIAL ARC BEARINGS Interim Report
H. G. Elrod, Jr. and J. T. McCabe Aug. 1967 40 p refs Sponsored by NASA, Dept. of Defense, and AEC
(Contract Nonr-2342(00))
(NASA-CR-91544; I-A2049-29; AD-661839) CFSTI: HC $3.00/MF $0.65 CSCL 13I

The side leakage effect in a high speed gas lubricated bearing was treated by two approximate methods. The first is a linearized ph solution of the asymptotic differential equation. The second is a Karman-Cohlhausen type boundary layer analysis. Both methods were applied to the flat slides and the results are shown to favorably agree with those of an accurate finite difference solution. The asymptotic approach is recommended for high speed (high lambda cases rather than the finite difference method because as lambda increases the accuracy of the asymptotic solution increases while the accuracy of the finite difference solution degenerates. Author (TAB)

N68-13860 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MECHANIZED PLOTTING OF SECOND ORDER CURVES ON A LOFT [MEKHANIZATSIYA VYCHERCHIVANIYA KRIVYKH VTOROGO PORYADKA NA PLAZE]
I. F. Mavlyutov *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 191–196 (See N68-13841 04-28)

Details are given on a device for mechanically drawing second-order curves and for determining the axes of the curves. The design principle is based on a lemma from projective geometry, i.e., a series of second-order points can be formed by two projected first-order clusters; the clusters, in turn, are formed by the projection of two persepctive series obtained by section of the same cluster of straight lines. The instrument consists of two legs, two rotating–sliding rods, one rotating trunnion, three movable knuckles with fixed legs, one sliding knuckle with a drawing leg, and two sliding knuckles. The system of trunnions is located in two planes only to improve precision and reliability. M.G.J.

N68-13861 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE TECHNOLOGICAL EFFICIENCY OF THE USAGE OF GEOMETRIC PARAMETERS IN COMPRESSOR BLADE DRAWINGS OF GAS TURBINE POWER PLANTS [K VOPROSU TEKHNOLOGICHNOSTI PROSTANOVKI GEOMETRICHESKIKH PARAMETROV V CHERTEZHAKH RABOCHIKH LOPATOK KOMPRESSORA GTD]
B. D. Tolpegin *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 197–201 (See N68-13841 04-28)

Dimensioning requirements determined by the technological process involved in processing the surfaces of various compressor blade sections are considered. Diagrams are presented to show that surface arrangements are determined by coordinating dimensions assigned in a rectangular system of coordinates. These parameters are referred to as internal geometric connections, while those parameters which fix the mutual positioning of the surface complexes are called external geometric connections. The interrelationship of the dimensioning in the drawing stage and the technological procedure involved in the actual production of the piece is delineated. The view is expressed that the mutual arrangement of two surface complexes will be definite provided six geometrical external connections (three linear and three angular) are given between their coordinate systems. These connections are considered technologically efficient if they are mutually independent. Author

N68-13875# Los Alamos Scientific Lab., N. Mex.
IMPROVED TEE CONNECTIONS FOR VACUUM SYSTEMS
Hermann M. Ruess [1967] 13 p refs Presented at 4th Gen. Meeting on Intern. Organ. for Vacuum Sci. and Technol., Manchester, England
(Contract W-7405-ENG-36)
(LA-DC-8978; CONF-680401-1) CFSTI: HC $3.00/MF $0.65

Improved welded tee connections are made by drawing a die of circular cross section through an elliptical cutout in the wall of the main tube to form a smooth tee transition. The shape of the cutout is such that the end of the tee is a flat surface requiring only minor weld preparation. The end of the tee is then butt welded by a full penetration fusion weld to the extension tube. This weld is simpler and more reliable than those required by other methods, sharp edges at the tee are eliminated, and the appearance and performance of the vacuum system are improved. Tooling required for the process is simple and inexpensive, and the process is easily adapted to single-system fabrication, mass production, or field application. Author (NSA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-12973* Sylvania Electric Products, Inc., Mountain View, Calif.
STABILIZED CO_2 GAS LASER Quarterly Report, Dec. 1, 1966–Mar. 1, 1967
1 Mar. 1967 36 p refs
(Contract NAS5-10309)
(NASA-CR-91352; QR-1) CFSTI: $3.00 CSCL 20E

Design and fabrication of a 20-watt, frequency-stabilized, single-frequency CO_2 laser is discussed. To achieve the 20-watt cw power level and maintain a required short-term frequency stability of 1 part in 10^{10}, a master oscillator-power amplifier approach was taken. The design of the oscillator cavity and laser tube and the temperature control system and automatic frequency control loop to be used with the laser are described. Preliminary tests indicated it may be possible to achieve the desired short-term frequency stability figure without the need for an external electronic control loop. Author

N68-13277*# Honeywell, Inc., Boston, Mass. Radiation Center.
AN ANALYTICAL AND EXPERIMENTAL INVESTIGATION OF LIMITED OPERATIONAL LIFE ON CO_2 LASERS TO ACHIEVE A NON FLOWING SEALED CO_2 GAS LASER
Final Report
J. F. Fantasia Oct. 1967 45 p
(Contract NAS12-590)
(NASA-CR-86015) CFSTI: HC $3.00/MF $0.65 CSCL 20E

Dissociation of pure carbon dioxide in a gas discharge, effects of water vapor and xenon upon dissociation, and influence of electrode material on clean-up rate were investigated in connection with the study to develop a nonflowing sealed CO_2 gas laser. The dominant CO_2 depletion mechanisms are found to be due initially to dissociation, followed by a steady clean-up of the dissociation products and the CO_2 by the electrodes. Dissociation rate is strongly dependent on additive gases and indirectly dependent on the clean-up rate for a given electrode material. A combination of nickel electrodes and carbon dioxide with water vapor added produced a very stable CO_2:CO:O_2 concentration. A system employing this combination could be expected to run for several hundreds of hours before total depletion of the CO_2 component occurs. M.W.R.

N68-13420# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORETICAL INVESTIGATION OF STABILITY OF FREQUENCY OF A MOLECULAR GENERATOR
A. N. Orayevskiy 5 Sep. 1967 89 p refs Transl. into ENGLISH from Tr. Fiz. Inst., Akad. Nauk SSR (Moscow), v. 21, 1963 p 1–67
(FTD-MT-65-467; AD-661863)

The study deals with the theoretical consideration of a number of questions connected with the construction of a standard of frequency (time) on the basis of a molecular generator. Equations describing not only a monochromatic, but also an established process arbitrarily changing in time are given. An analysis is made of the effects influencing the frequency of molecular generator (M.G.) oscillations as a function of different parameters. Different methods of the tuning of the M.G. frequency of a spectral line are analyzed. A quantitative appraisal of the possibility of tuning by means of modulation of line width to an external magnetic field is given. The possibility of the use of two connected resonators for tuning the M.G. frequency on the frequency spectral line is shown. Possibilities of further increase in stability of the M.G. frequency are considered. A series of method is proposed for obtaining slow molecules whose average speed is considerably less than the thermal velocity at room temperature. Author (TAB)

N68-13426 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
JOURNAL OF APPLIED SPECTROSCOPY
27 Apr. 1967 26 p refs Transl. into ENGLISH from Zh. Prikl. Spektry., (USSR), v. 6, no. 1, 1966 p 36–44, 51–55
(FTD-HT-67-59; AD-661377)

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2. THERMAL DEFORMATION OF THE RESONATOR OF A SOLID-STATE OPTICAL QUANTUM GENERATOR Yu. A. Anan'yev, N. A. Kozlov, A. A. Mak, and A. I. Stepanov p 14–22 refs (See N68-13428 04-16)

N68-13427 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF ENHANCED LUMINESCENCE ON THE GENERATION CHARACTERISTICS OF SOLID-STATE LASERS [VLIYANIYE USILENNOY LYUMINESTSENTSII NA KHARAKTERISTIKI GENERATSII TVERDOTEL'NYKH OPTICHESKIKH KVANTOVYKH GENERATOROV]
A. M. Samson *In its* J. of Appl. Spectry. 27 Apr. 1967 p 1–13 refs (See N68-13426 04-16)

The effect of amplified luminescence on the generation capacity of lasers depending on the dimensions of the rods is investigated. The study is performed to determine the effect of amplified luminescence on the threshold and generation power as a function of the length of the rod, the reflection coefficients of the outer mirrors, and the parameters of the internal losses. It is shown that an increase in the rod length may lead to a break in the generation, and that with standard rod lengths the threshold is several times higher than when the amplified luminescence is not taken into account. Author

N68-13428 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL DEFORMATION OF THE RESONATOR OF A SOLID-STATE OPTICAL QUANTUM GENERATOR [TERMICHESKAYA DEFORMATSIYA REZONATORA TVERDOTEL'NOGO OPTICHESKOGO KVANTOVOGO GENERATORA]
Yu. A. Anan'yev, N. A. Kozlov, A. A. Mak, and A. I. Stepanov *In its* J. of Appl. Spectry. 27 Apr. 1967 p 14–22 refs (See N68-13426 04-16)

The thermal deformation of a laser resonator due to nonuniform heating by the active material was investigated. The experiment was carried out with cylindrical specimens of neodymium glass with frosted lateral faces pumped by a xenon flashlamp. The experimental set-up used is described and illustrated. Considerable deformation of the resonator was observed in all the modes tested. A comparison of the experimental data with the calculations performed revealed that with increasing temperature drop in the specimen, the deviation of the experimental and the calculated quantities of the optic behavior increases, reaching a peak at T = 38C. In order to determine the reasons for this divergence, a study was made of the deformation of the end faces of the specimens, as well as of the birefringence in them due to thermal stresses. The results obtained show that the deformation of a laser resonator during optical pumping of an activated specimen is due to the nonuniformity of the temperature distribution in the specimen as well as to the thermal stresses resulting from this nonuniformity. Furthermore, at high temperature drops the effect due to these stresses is substantial. Author

N68-13429# Boeing Co., Renton, Wash. Commercial Airplane Div.
SOME CHARACTERISTICS OF AQUEOUS STRESS CORROSION
Daniel N. Fager and William F. Spurr Sep. 1967 17 p
(Contract N00014-66-C-0365; ARPA Order 878)
(D6-60083; AD-661813)

The influence of microstructural features on the stress corrosion fracture path was studied in the alloys Ti-8Al-1Mo-1V, Ti-6Al-4V, Ti-4Al-3Mo-1V, Ti-5Al-2.5Sn, and Ti-13V-11Cr-3Al by means of optical microscopy, electron microscopy, and X-ray diffraction. These studies showed that susceptibility of titanium alloys to aqueous stress corrosion is influenced by crystalline structure of the susceptible phase (bcc or hcp), preferred grain orientation, and relative phase

content where one phase is immune. Stress corrosion cracking occurs on or near the (100) planes in the bcc beta phase, but can only occur near the single (0001) plane in the hcp alpha phase. This restriction of cracking in the alpha phase results in a significant influence due to preferred orientation; it also contributes to the influence of stress state on susceptibility in the high-alpha alloys. The apparent lack of correlation between the structures of the phases and their stress corrosion susceptibilities indicates that the basic mechanism is surface-controlled rather than structurally controlled. Author (TAB)

N68-13466# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
GEOPHYSICAL RESEARCH
G. Fiocco and G. W. Grams *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 37–43 (See N68-13461 04-23)
(Contract NAS12-436; Grants NGR-22-009-131; NGR-22-009-114)

Preliminary measurements on the spectrum of light scattered from air in a laboratory containing natural aerosol particles, and from air containing an artificially produced fog are reported. Interferometric analysis of the echoes from a laser output of 0.7 mW at 6328 Å showed a substantially higher signal level for the light spectrum scattered from the artificially produced fog; the noisiness of the spectral scans obtained from airosol particles was attributed to nonstationary character of the aerosol particle distribution. Measurements of electron temperature and density of plasma discharge into helium by scattering of continuous wave A^+ laser radiation at 4880 Å established 4.8×10^{18} m^{-3} as the value for electron density from scattering data when the electron temperature was 1.2 eV. G.G.

N68-13490*# Sylvania Electric Products, Inc., Mountain View, Calif.
STABILIZED CO_2 GAS LASER Quarterly Report, Mar. 1–Jun. 1, 1967
1 Jun. 1967 47 p refs
(Contract NAS5-10309)
(NASA-CR-91353; QR-2) CFSTI: HC$3.00/MF$0.65 CSCL 20E

Design, fabrication, and testing were continued for the development of a sealed-off, 20-watt, stabilized single-frequency CO_2 laser. Described are the (1) efforts toward obtainment of single-mode operation in the laser with maximum output power, (2) amplifier gain studies, (3) thermal stability measurements of the laser cavity, (4) mechanical design of the oscillator–amplifier package and (5) thermal control and automatic frequency control electronics. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-12826# Bureau of Mines, Minneapolis, Minn.
PHYSICAL STRENGTH OF IRON ORE PELLETS AT ELEVATED TEMPERATURES
J. L. Reuss and M. M. Fine Jan. 1968 29 p refs
(BM-RI-7060)

Softening characteristics of both unfired and indurated iron ore pellets were measured by hot compression strength in a laboratory study. A surprisingly high hot strength (240 lb per 1/2-inch spheroid) was developed by unfired magnetite pellets near 900°C; lesser maxima were developed by pellets made from hematite and specularite concentrates near 1,000°C. Those from goethite remained weak throughout the preinduration heating. Fully indurated commercial pellets retain a high resistance to softening when heated in air, but in a hot reducing atmosphere their high cold crushing strength dissipates rapidly. At 1,000°C, for example, the average compression strength of seven different commercial pellets was 110 lb; at 1,100°C, the hot strength was only 60 lb. After a rather sharp initial drop, the loss of strength with increase of temperature was gradual. There was no sudden collapse, nor any significant difference, in behavior of commerical pellets whether made from magnetite or hematite concentrates. Author

N68-12867# Naval Research Lab., Washington, D. C.
CORROSION OF METALS IN TROPICAL ENVIRONMENTS. PART 8. NICKEL AND NICKEL–COPPER ALLOYS: SIXTEEN YEARS' EXPOSURE
C. R. Southwell and A. L. Alexander 4 Oct. 1967 31 p refs
(NRL-6592; AD-661835)

Corrosion of nickel and nickel–copper alloys in five natural tropical environments is reported for exposure periods of 1, 2, 4, 8, and 16 years. Data collected include weight loss, pitting, change in tensile strength of simple plates, and weight loss of galvanic couples. Corrosion in the tropics is compared with available exposure results from temperate latitudes in the United States, and generally the tropical corrosion was appreciably higher. The weight-loss-vs-time curves are normally curvilinear relations but considerable variation in the direction and magnitude of the curvature was observed for the different metals and environments. With respect to pitting, the high nickel alloys developed severe early pitting under sea water. However, the initial high penetration rates leveled off to very low rates after the first 1 to 2 years' exposure. Comparison under tropical sea water of monel and copper–nickel with various other nonferrous metals shows copper–nickel with comparatively high corrosion resistance, but monel with the lowest sea-water resistance of the group. Galvanic corrosion results show the long-term efficiency of carbon steel anodes in cathodically protecting nickel–copper alloys in sea water. Additional galvanic data reveal that considerable anodic corrosion can be induced in a normally sea-resistant metal if coupled with certain nickel alloys. The nickel metals were highly resistant to corrosion in the tropical atmospheres. There was no measurable pitting in these terrestrial exposures and only small weight losses. The losses that were measured though showed increasing resistance of the metals with increasing nickel content. Since tropical corrosion is near the upper limit of corrosiveness of natural environments, these long-term results should afford safe, practical information for design and protection of structures in all latitudes. Author (TAB)

N68-12881# Sandia Corp., Albuquerque, N. Mex.
DYNAMIC BEHAVIOR OF BERYLLIUM
D. E. Munson Jun. 1967 10 p refs
(SC-RR-67-368) CFSTI: HC$3.00/MF$0.65

The dynamic behavior of QMV Be sheet was determined from plate impact experiments. It has a pronounced elastic–plastic, rate sensitive stress–strain behavior. Suitable analysis to obtain bulk propagation velocities indicates two important functions with a phase change at approximately 93 kbar. Author (NSA)

N68-12891*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRESS-CORROSION CRACKING OF Ti-6Al-4V TITANIUM ALLOY IN NITROGEN TETROXIDE
W. Barry Lisagor, Charles R. Manning, Jr., and Thomas T. Bales Washington Jan. 1968 33 p refs
(NASA-TN-D-4289) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The stress-corrosion of Ti-6Al-4V titanium alloy in nitrogen tetroxide was investigated by using small laboratory-size

self-stressed specimens and tanks. Tests were conducted from 65°F to 165°F (290°K to 345°K) for purposes of determining the time for crack initiation. Stress levels from 25 to 100 ksi (170 to 690 MN/m^2) were investigated and crack initiation was observed at all stress levels in approximately the same time. An excellent correlation was obtained between crack initiation time on laboratory specimens and failure time for tanks. Tests were also conducted on specimens which had been treated in some manner for the prevention of stress-corrosion attack. Organic and metallic coatings investigated proved to be unsatisfactory because of adherence problems or apparent permeation resulting in stress-corrosion attack. Surface treatments including peening techniques proved to be beneficial and glass-bead peening to introduce residual compressive stresses of high magnitude appeared to alleviate the problem entirely for the range of tests conducted. The residual stress level was determined by X-ray diffraction techniques and was found to be in excess of 100 ksi (690 MN/m^2) on the surface. The prevention of stress-corrosion attack by chemical inhibition with 0.78 percent by mass nitric oxide (NO) added to the N_2O_4 was also substantiated by tests conducted at 165°F (345°K) for exposures of 170 hours. The mechanism of prevention remains unknown.
Author

N68-12895# National Engineering Lab., Glasgow (Scotland).
CORRELATION OF A FRACTURE MECHANICS PARAMETER WITH MECHANICAL PROPERTIES FOR HIGH-STRENGTH STEELS
L. P. Pook Apr. 1966 46 p refs
(NEL-225)

A survey has been made of the available information on values of the fracture mechanics parameter K_{1C} for various high-strength steels. The results of tests on two different high-strength steels are also given. The data were examined to see whether there was any relationship between K_{1C} and conventional mechanical properties. It was found that there is a correlation between K_{1C} and the reduction of area as measured in a tensile test. The correlation band is too wide for accurate estimates of K_{1C} to be made from the reduction of area, but it can be used to check the validity of a test method for finding K_{1C}. Cracked cylindrical specimens, fatigue cracked in rotating bending, often used to determine K_{1C} were found to give values which were low.
Author

N68-12961# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
EFFECT OF PURITY AND TEMPERATURE ON DYNAMIC MICROSTRAIN OF NIOBIUM (Cb)
Robert D. Carnahan, Richard J. Arsenault (Maryland Univ., College Park), and Glen A. Stone (Franklin Inst., Philadelphia) Jul. 1967 32 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-7; SAMSO-TR-67-60; AD-661964)

An experimental technique was developed for a dynamic tensile stress-strain test in which plastic strain is measured continuously throughout the microstrain region extending through the macroflow region to total deformations of 5%. The tests were carried out on Nb samples having interstitial impurity levels of 160 and approximately 800 ppm at temperatures ranging from room temperature down to 100K. A band spectrum of activation energies was obtained from calculations based on the measured activation volumes and temperature dependence of flow stress. The inability to predict such a phenomenon on the basis of a single rate-controlling process has led to the proposal that several sequential rate-controlling dislocation mechanisms are operative in the preyield microstrain region. These are thought to be the motion of geometrical kinks, the formation of double kinks in edges, and finally, in the macrostrain region, the formation of double kinks in screws. In less pure Nb the effect of interstitial impurities is shown to be dominant in the microstrain region a result which suggests that a fourth mechanism is overcoming interstitial barriers rather than the motion geometrical kinks and formation of double kinks in edge dislocations.
Author (TAB)

N68-12980# New York Univ., N. Y. Research Div.
THERMODYNAMIC PROPERTIES OF THE Cr–Al AND V–Al SYSTEMS Final Report, 1 Mar. 1965–28 Feb. 1967
William Johnson, Kurt Komarek, and Edward Miller Aug. 1967 48 p refs
(Contract Nonr-285(64))
(AD-661352)

The activity of aluminum in solid chromium-aluminum and vanadium aluminum alloys was determined between 15 and 80 at.% Al in both systems, by an isopiestic method from specimens equilibrated at temperatures between 1170 and 1400K. Partial molar free energies, enthalpies and entropies and integral thermodynamic parameters were calculated at 1273K. In the Cr-Al system the departure of the activity of aluminum from ideal behavior is highly negative in the solid solution of Al in Cr and the high melting Cr5Al8 intermetallic compound. The entropy of mixing for the solid solution of Al in Cr is positive. A sharp change to a more negative integral entropy of mixing occurs for Cr5Al8, Cr4Al9 and CrAl4 intermetallic compounds, with a value of -1.54 e.u. at 80 at.% Al. In addition, the integral free energy of mixing at 1273K reaches its largest value (-5.900 cal/gr.-atom) at 59 at.% Al. The phase boundaries determined in this investigation disagree with those presented by Bradley and Lu, but are in substantial agreement with the work of Koester, Wachtel and Grube. The activity in the V-Al system also exhibits a marked negative deviation from ideality, with values close to that of the Cr-Al system. The phase boundaries obtained disagree with those presented by Hansen, but are in good agreement with those of Carlson, Kenney and Wilhelm.
Author (TAB)

N68-13067 Naval Research Lab., Washington, D. C.
ROLE OF LOCAL DISSOLUTION IN CORROSION-ASSISTED CRACKING OF TITANIUM ALLOYS
J. M. Kraft *In its* Rept. of NRL Progr. Mar. 1967 p 6–18 refs Sponsored in part by ARPA (See N68-13065 04-34)

This investigation shows that the lifetime before fast fracture of cracked beams of various titanium alloys immersed in salt water can be predicted from a model in a way that is indicative of a constant dissolution velocity. The magnitude of the dissolution velocity is consistent with known rates for plastically deforming tensile rods. To achieve this correlation it was necessary to correct an earlier model of tensile instability for effects of triaxiality and local compliance. When applied to other cases of plane-strain facture, these corrections remove several inconsistencies found in earlier attempts to apply the simple uniaxial model. The results suggest that, if the dissolution velocity is inherently high, resistance to stress-corrosion cracking is favored by a large process zone size, or diameter of the ligamental cell, and by a high yield strength.
Author

N68-13112# Aerospace Corp., El Segundo, Calif.
HYDROGEN-STRESS CRACKING OF 17-4 PH STAINLESS
Louis Raymond and Ernest G. Kendall Aug. 1967 26 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-6; SAMSO-TR-67-59; AD-661958)

The susceptibility of 17-4PH to hydrogen-stress cracking was found to increase as the hardness of the steel increased from 42 to 47 R sub c. Conditions of hydrogen-stress cracking were created by attaching a piece of aluminum (7075-T6) to a stress corrosion test specimen. In the absence of aluminum, under identical test conditions, no stress-corrosion cracking failures were recorded in times up to 1000 hr. Charging the bolts with hydrogen and statically loading the bolts in air produced failure times similar to those obtained with the test samples coupled to the aluminum alloy and periodically immersed in a 3-1/2% salt solution. When the 17-4PH was over-aged to a hardness of 40 R sub c or less,

the susceptibility was eliminated. These variations in hardness did not change the yield point of the bolt (as determined by the Johnsons 2/3 method). Three additional methods of protection against hydrogen-stress cracking were evaluated: nickel-cadmium electroplating of the bolts, anodizing the aluminum, and insulating with a lubricant at the aluminum/stainless steel interface. Nickel-cadmium plating (AMS-2416) the 17-4PH to a thickness of from 0.2- to 0.4- mil nickel/0.1- to 0.2- mil cadmium offered no resistance to hydrogen-stress cracking. The remaining two methods proved effective in inhibiting hydrogen-stress cracking under controlled laboratory conditions, but, with poor handling procedures, the dissimilar metal couple could be easily activated and cause failure by hydrogen-stress cracking. Author (TAB)

N68-13126# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.

WORK-HARDENING MODEL FOR THE EFFECT OF GRAIN SIZE ON THE FLOWSTRESS OF NIOBIUM STRAINED BY ROLLING

Hans Conrad, Seymour Feverstein, and Larry A. Rice Oct. 1967 32 p refs

(Contract F04695-67-C-0158)

(TR-0158(3250-20)-4; SAMSO-TR-67-61; AD-661965)

Effect of grain size in the range of 32 to 435 microns on the dislocation density and structure and the flow stress of 125-microns niobium foil rolled various amounts at room temperature was investigated. For a given grain size d the dislocation density increased in an approximately linear manner with the rolling reduction, the rate of increase being proportional to 1/d. The shear flow stress tau increased with the square root of the dislocation density independent of grain size in accord with the relation tau - tau sub f + 0.60 G b rho to the 1/2 power. Effect of grain size on flow stress is thus explained in terms of a work-hardening model based on long-range stress fields of dislocations, rather than a Hall-Petch pile-up model. The strain at which a well-defined cellular network of dislocations first developed increased with an increase in grain size. Once the cell structure formed, the cell size tended to decrease with further straining. The cell size at a rolling reduction of 10% varied approximately as d to the 1/3 power. The results on the rolled niobium foil are compared with those obtained on identical material strained in tension. Although there are some differences between the two methods of straining, the general behavior is similar. Author (TAB)

N68-13250# Naval Ship Research and Development Center, Annapolis, Md.

EMBRITTLEMENT OF TITANIUM IN SEAWATER

J. L. Cavallaro Oct. 1967 44 p refs

(NSRDC-2483; AD-661463)

Sea-water stress- corrosion tests on notched cantilever-beam specimens of Alloy Ti-7Al-2Cb-1Ta (Ti-721) demonstrated that it has a transition in behavior with increasing notch sharpness. Sea-water tests on Alloy Ti-721 indicate that a threshold stress level exists below which stress corrosion does not occur. Sea-water stress corrosion is dependent on the presence of embrittling constituents in the alloy. Alloy chemistry and heat treatment are the most significant factors which control sensitivity. The results of tests made on a series of Ti-Al binary alloys indicate that aluminum in solid solution does not cause stress corrosion, but that it is caused by a finite amount of a coherent Ti_3Al. A decrease in aluminum and oxygen contents and the addition of isomorphous beta stabilizers improve the resistance of Ti-Al alloys to sea-water stress corrosion by suppressing the formation of Ti_3Al. A stress-sorption cracking mechanism is suggested as a general model for the embrittlement of titanium and titanium alloys in seawater. Author (TAB)

N68-13353# Boeing Co., Renton, Wash. Commercial Airplane Div.

SOME OBSERVATIONS ON THE STRESS-CORROSION CRACKING OF THREE COMMERCIAL TITANIUM ALLOYS

James C. Williams Sep. 1967 8 p refs

(Contract N00014-66-C0365; ARPA Order 878)

(D6-19553; AD-661812)

Stress-corrosion cracking was studied in commercial titanium alloys Ti-8Al-1Mo-1V, Ti-6Al-4V, and Ti-4Al-3Mo-1V. Electron fractography was used in conjunction with electron metallography to establish the fracture path. A sharp transition from ductile to cleavage failure occurs in the alpha phase between 4 and 6 weight percent aluminum, while the beta phase fails by ductile rupture in all cases. Thin-foil electron microscopy was used to show that the dislocation arrangements produced in the alpha phase range from tangles in the 4 weight percent aluminum alloy to coplanar arrays in the 6 and 8 weight percent alloys. The relation between dislocation arrangements and fracture mode offers a qualitative explanation of the variations in environmental susceptibility of various titanium alloys. Author (TAB)

N68-13385# Uppsala Univ. (Sweden). Inst. of Physics.

DISLOCATION STRUCTURE OF AN AUSTENITIC STAINLESS STEEL IN DIFFERENT STAGES OF FATIGUE

O. Vingsbo, G. Lagerberg, B. Hansson, and Y. Bergstroem Aug. 1966 34 p refs

(UUIP-493)

The dislocation structure in austenitic stainless steels at different stages of fatigue were studied by means of transmission electron microscopy. For stress amplitudes well below the endurance limit (defined as the stress amplitude giving fracture beyond 10^7 cycles) a structure of randomly distributed slips dislocations of low density was built up and remained unchanged from 10^4 cycles. At the end of the lifetime of specimens fatigued above the endurance limit, the dislocations occurred in dense tangles, which frequently were arranged in cell walls. The tangles were clustered with dislocation loops elongated in a (211) direction. Also parallel rows of elongated loops were observed. Stocking fault tetrahedrons of an irregular distribution were found. The stacking fault energy of the material was estimated from the edge length of the largest observed tetrahedrons. A complementary experiment indicated that stacking fault tetrahedrons in the present materials are not of vacancy origin. A detailed study shows that stacking fault tetrahedrons as well as the observed elongated loops may be formed by a dislocation mechanism. This mechanism includes the process of screw dislocation cross slip, and it is suggested that cross slip in stainless steel during cyclic loading is possible also at moderate stresses. A dislocation mechanism for crack nucleation involving the formation of crystal voids from strings of intrinsic prismatic dislocation loops is proposed. Author (NSA)

N68-13489# Los Alamos Scientific Lab., N. Mex.

ORTHORHOMBIC β-PHASES OF NIOBIUM AND VANADIUM CARBIDES

S. I. Aliamovskii, G. P. Shveikin, P. V. Gel'd, and N. M. Volkova [1967] 11 p refs Transl. into ENGLISH from Zh. Neorg. Khim. (Moscow), v. 12, 1967 p 579-582

(LA-TR-67-73) CFSTI: HC $3.00/MF $0.65

The study of β'-phases in Nb_2C and V_2C is presented. Data from X-ray diffraction analyses are listed. The introduction of small impurities of N_2 and O_2 promotes the rearrangement of the hexagonal lattice of the lower carbides into the orthorhombic. The structures of the orthorhombic β'-phase of Nb_2C and V_2C were determined, and the conditions of stabilizing them are explained. Author (NSA)

N68-13625*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

DEVELOPMENT OF DISPERSION STRENGTHENED TANTALUM BASE ALLOY Quarterly Progress Report, 20 Aug.-20 Nov. 1966

R. W. Buckman, Jr. and R. C. Goodspeed 20 Nov. 1966 40 p refs
(Contract NAS3-2542)
(NASA-CR-72316; WANL-PR-(Q)-013; QPR-12) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Development of dispersion strengthened tantalum base alloys for use in advanced space power systems continued with the processing of compositions Ta–8W–1Re–1Hf(ASTAR-811) and Ta–7W–1Re–1Hf–0.012C–0.012N(ASTAR-811CN) to 0.04 inch thick sheet. Primary breakdown of the 4 inch diameter consumable electrode melted ingots was by upset or side forging at 1400°C (2550°F) on the Dynapak. Tensile properties were determined over the temperature range of −320 to 3000°F. As–TIG welded sheet specimen of ASTAR-811 and ASTAR-811CN were ductile when bent over a radius of 1t at −320 and −225°F respectively. As-rolled sheet, 33% prior reduction, of both compositions was completely recrystallized after heating for 1 hour at 1600°C. The study of creep properties, phase identification, and effect of heat treatment on phase stability of ASTAR-811 and ASTAR-811CN was initiated. Preliminary results on ASTAR-811CN indicate that only the dimetal carbide is present in the as-cast ingot. Author

N68-13627*# Chromalloy Corp., West Nyack, N. Y.
PROTECTIVE COATINGS FOR CHROMIUM ALLOYS Final Summary Report, Nov. 1, 1965–Jul. 13, 1967
Marvin Negrin and Allan Block 13 Jul. 1967 178 p refs
(Contract NAS3-7273)
(NASA-CR-54538) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A variety of aluminum-base coatings were deposited by pack-cementation methods on a prototype chromium base alloy Cr–5W–Y. The coatings were of both the simple and modified aluminum types. Promising systems were examined in great detail by cyclic and continuous oxidation, ductile–brittle-transition testing, metallography, and electron beam microporbe techniques. Of the systems studied, a simple aluminum (Cr_5Al_8-type) and iron–aluminum [$(Fe–Cr)_xAl_y$ type] produced the best results. Under static oxidation (cyclic–static) these systems survived >1000 hours at 2100°F and approximately 200 hours at 2400°F. Under dynamic conditions coating failures appeared in much shorter periods of time. Protectiveness of these systems is closely related to $AlCr_2O_4$, and $FeO-Al-Cr_2O_4$ type spinel formation. Life of these systems is further limited to a point where nitrogen penetration of the substrate is observed. Author

N68-13630*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
DEVELOPMENT OF DISPERSION STRENGTHENED TANTALUM BASE ALLOY Quarterly Progress Report, Nov. 20, 1966–Feb. 20, 1967
R. W. Buckman, Jr. and R. C. Goodspeed 20 Feb. 1967 38 p refs
(Contract NAS3-2542)
(NASA-CR-72306; WANL-PR-(Q)-014; QPR-13) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Development of dispersion strengthened tantalum base alloys for use in advanced space power systems continued as the evaluation of Ta–8W–1Re–1 Hf (Astar-811) and Ta–7W–1 Re–1 Hf–0.012C–0.012N (Astar-811CN) sheet material was essentially completed. tensile properties of TIG welded sheet specimens of both alloys were determined over the temperature range of −320° to 2600° F. One hour post weld anneals at temperatures ranging from 1800° to 2600° F resulted in an increase in the ductile–brittle transition temperature of TIG welded ASTAR-811CN, while the transition temperature of TIG welded ASTAR-811 remained below −320°F. Phase identification studies on ASTAR-811CN indicated that the HCP tantalum dimetal carbide is the precipitate which occurs during processing to 0.04 inch sheet and short time anneals. The FCC carbonitride phase occurs at the expense of the dimetal carbide during longer (≥16 hours) anneals at temperatures of about 2400°F and higher. The scope of work this period was expanded to include an investigation of the effect of grain size and annealing temperatures on the creep properties of ASTAR-811, ASTAR-811CN, and ASTAR-811C (Ta–8W–1Re–0.7Hf–0.025C). Grain size data were obtained on these alloys as a function of annealing time and temperature. Author

N68-13631*# TRW Equipment Labs., Cleveland, Ohio. Materials Research and Development Dept.
GENERATION OF LONG TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES
J. C. Sawyer and K. D. Sheffler 1 Aug. 1967 51 p refs
(Contract NAS3-9439)
(NASA-CR-72319) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Molybdenum-base TZC and TZM alloys and tantalum-base T-111 and Astar 811C are being creep tested in a vacuum environment of 1×10^{-8} Torr. Test temperatures range from 1600° to 2600°F and stresses from 0.5 to 65 Ksi. Test parameters were selected to provide 0.5–1.0% creep in 5,000 to 15,000 hours. Test results with molybdenum-base TZC and TZM show the effects of variations in chemistry and method of processing. Tests with tantalum-base T-111 reveal that significant variations in creep strength can occur between heats of materials. Data are presented to suggest that low creep strength of T-111 alloy may be the result of fine grain size. Comparison of tantalum-base Astar 811C with T-111 shows the superior creep properties of the Astar 811C alloy. Author

N68-13658*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
ADVANCED REFRACTORY ALLOY CORROSION LOOP PROGRAM Quarterly Progress Report, 15 Jan.–15 Apr. 1967
R. W. Harrison, ed. 15 Apr. 1967 51 p refs
(Contract NAS3-6474)
(NASA-CR-72335; QPR-8) CFSTI: HC $3.00/MF $0.65 CSCL 11F

All the refractory alloy materials for construction of Corrosion Loop I (T-111) have been received and quality assurance inspected. A trial lithium distillation run is in progress to determine the operational characteristics and the extent of lithium purification achieved by distillation. Fabrication of loop components is in progress with most major components nearing completion. The ASTAR 811 and ASTAR 811CN tantalum alloy specimens have been contaminated with oxygen to the desired levels in preparation for the lithium and potassium capsule tests. Author

N68-13737*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report
J. Rexer 18 Dec. 1967 8 p refs
(Contract NASw-1405)
(NASA-CR-91539; PR-5) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A spring-loaded microbend tester was designed and is being constructed. The microbend tester will be mounted on a microscope platform permitting side-of-beam observations of metallographically polished surfaces during deformation. The applied load will be measured by means of a spring-loaded balance having a marker recording the maximum applied load. Flexural strengths will be calculated from the data obtained with iridium coated and heat-treated samples. A previous malfunction of the temperature control unit resulted in extensive damage to the heat-treating apparatus. This apparatus and the control unit have been repaired. The best control settings for the controller were established permitting set-point control of the temperature of the tungsten crucible within the range 1100° to 2100°C. A calibration curve was obtained for the new thermocouple, and the radial temperature distribution within the tungsten crucible was established at various temperature settings. Author

N68-13751# Iowa State Univ. of Science and Technology, Ames.
A MAGNETIC RESONANCE STUDY OF THE VANADIUM–CHROMIUM SYSTEM AND OF THE NEEL TEMPERATURES OF THE CHROMIUM-RICH ALLOYS
Thomas Peter Graham (Ph.D. Thesis) Aug. 1967 139 p refs
(Contract W-7405-ENG-82)
(IS-T-155) CFSTI: HC$3.00/MF$0.65

The magnetic resonance of ^{51}V was studied throughout the composition range of the bcc vanadium–chromium alloys. The ^{53}Cr resonance was studied in pure chromium metal and a few of the dilute chromium alloys. On the basis of a rigid two-band model, the composition dependence of the ^{51}V Knight shifts was shown to be due to the interplay of the orbital and the negative core polarization contributions to the shift. The spin–lattice relaxation time of ^{51}V in the alloys was found to depend primarily on the density of d-electron states at the Fermi surface. The ^{53}Cr Knight shift was found to be predominantly orbital in origin. Evidence was found for the occurrence of quadrupole interactions in this system. This was based on measurements of the resonance intensity and line width supplemented by the observation of narrow spin-echo widths. The effect of impurity screening on the quadrupole interactions and line widths is qualitatively discussed. The Neel temperatures of chromium and of a series of dilute vanadium–chromium alloys were measured. The extinction of the resonance at the antiferromagnetic transition was used as the criterion to determine these temperatures. The Neel temperatures decreased rapidly as the vanadium concentration was increased. These temperatures extrapolate to zero Neel temperature at a vanadium concentration of about 3.5%. These results are discussed in terms of the current theory of antiferromagnetism in chromium.
Author (NSA)

N68-13800 Akademiya Nauk SSSR, Novosibirsk.
SHOCK-WAVE COMPRESSION OF SOME INORGANIC COMPOSITIONS
A. Deribas, N. Dobretsov, V. Kudinov, V. Maly, A. Serebrjakov, et al [1967] 7 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

Shock wave compressed silicates and mixtures of Fe–W and W–C powders were analyzed by X-ray diffraction. Compressed SiO_2 showed the formation of stipoverite; formation of an amorphous phase in $MgSiO_3$ and $NaAlSi_3O_8$ was attributed to decomposition. X-ray analysis of shocked Fe–W mixtures showed the lines of Fe and W displaced to smaller angles as compared with the lines of the original materials; this line displacement was connected with the formation of the solid solutions: W—Fe (substitutional solution), and Fe–W (interstitial solution). Compressed W–C powder mixtures showed the formation of W_2C.
G.G.

N68-13805*# Union Carbide Corp., Parma, Ohio. Carbon Products Div.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS Progress Report, 21 Jul.–21 Oct. 1967
J. Rexer [1967] 11 p ref
(Contract NASw-1405)
(NASA-CR-91537; PR-6) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Progress is summarized in a program to (1) measure the change in thickness of an iridium coating on the refractory metals tungsten, molybdenum, and niobium due to interdiffusion and intermetallic compound formation, and (2) examine microscopically with a microbend tester the mechanical behavior of iridium coated and heat treated specimens. It is reported that construction of a microbend tester was completed, and that the performance of the device was checked using small strips of steel. The flexural strength values obtained for grade ATJ graphite were compared with values obtained on standard size samples. Tests were conducted on polished strips of molybdenum and tungsten, and molybdenum–iridium diffusion samples were hot pressed.
C.T.C.

N68-13883# Battelle Memorial Inst., Geneva (Switzerland).
RESEARCH TO DETERMINE THE LONG-TERM MECHANICAL PROPERTIES OF METALS SUBJECTED TO MECHANICAL STRESS AT ELEVATED TEMPERATURES AND NEUTRON IRRADIATION Final Report
W. Siegfried and S. Zimering Jul. 1967 61 p refs
(Contracts EURATOM-100-62-12 RDS; EURATOM-057-64-7-EES (RD))
(EURAEC-1921; EUR-3752) CFSTI: HC$3.00/MF$0.65

The relationships between the shape of time-to-rupture curves and certain kinematic values which can be calculated on the basis of the physical theories are presented for irradiated metals. A basis is obtained for developing new extrapolation methods by means of which the results of measurements of physical values can be introduced into the calculation quantitatively. It can be expected that a substantial reduction of cost and necessary test time can be achieved for determining the long-time mechanical properties at high temperature and under neutron irradiation. The results obtained also make it possible to evaluate summarily the available results of technological time-to-rupture tests which have been made at high temperatures and under neutron irradiation, and those of physical investigations as regards the influence of neutron irradiation on the mechanical properties. Considerable improvement of the situation towards determining the long-time mechanical properties and developing new materials can be expected from such an evaluation of investigations already available.
Author (NSA)

N68-13867# Battelle-Memorial Inst., Geneva (Switzerland).
NEW METHODS FOR PHYSICAL INTERPRETATION OF TIME-TO-RUPTURE TESTS Third Special Report
W. Siegfried 30 Aug. 1967 165 p refs
(Contract EURATOM-100-62-12-RDS)
(EURAEC-1908; EUR-3393) CFSTI: HC$3.00/MF$0.65

Values with a defined physical meaning, whose computation is possible on the basis of the physical elementary mechanisms taking place, have been calculated by means of time-to-rupture tests whose nominal stress and constriction of rupture as a function of time to rupture have been measured. These are the following: volume of activation as a function of stress; secondary creep rate as a function of stress; and number of fissure germs as a function of secondary creep rate. After discussion of simplifications based on investigations of an estimate of possible errors to be expected, and of determination of the field of validity, the mechanism of rupture formation during the time-to-rupture test is subdivided into the following classes of partial mechanisms: mechanisms of deformation characterized by the volume of activation and the part of volume participating in the deformation; germination and growth of fissures; and formation of a constriction. This subdivision permits the above-mentioned physical values to be determined without going into all details of the physical models. The following time-to-rupture tests are discussed in more detail: time-to-rupture tests on two Cr–Ni–Ti-alloys at different temperatures before and after neutron irradiation; in-pile time-to-rupture tests and corresponding off-reactor control tests on a 304-stainless steel at different temperatures; and time-to-rupture tests without neutron irradiation on a Cr–Mo–V cast steel with abnormal behavior.
Author (NSA)

N68-13893# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
CRYOGENIC AND AMBIENT TENSILE AND COMPRESSION PROPERTIES OF HOT-PRESSED BLOCK BERYLLIUM
R. L. Kesterson Jun. 1967 45 p refs
(WANL-TME-1619) CFSTI: HC$3.00/MF$0.65

The tensile and compression properties of S-200 grade Be were investigated in the temperature range of +70°F to −320°F. This hot-pressed block material is presently being used for both sector and ring types of NERVA outer reflectors. The objectives of this investigation included: statistical comparison of the mechanical properties of ring and sector material; statistical

comparison of the lot to lot variation in the mechanical properties of hot-pressed Be; statistical study of the testing temperature effect on the mechanical properties; and study of the notched tensile behavior. The experiment was designed so that a statistical data analysis would produce an optimum amount of information. The results from the analysis were used to develop stress–strain curves with 75%, 90%, 95%, and 99% tolerance limits with a 90% confidence factor. The results indicate that on a statistical basis no real difference exists between the cryogenic mechanical properties of the ring and block pressings. However, there is less variance in properties of ring-type pressings, and thus this type of Be pressing is favored. Author (NSA)

N68-13903# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
NORMAL FREEZING WITH CUBIC LIQUIDUS AND SOLIDUS LINES
C. H. Li Dec. 1967 16 p refs Submitted for publication
(RM-393J)

The derivation is given of an equation for the normal freezing of binary systems which have cubic, or higher-order, liquidus and solidus curves. An example of the use of these equations in the cubic case shows that, at least in the Au–Ag system, the cubic normal freezing equation represents a distinct improvement over the linear or even quadratic normal freezing equation. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-12806# Naval Torpedo Station, Keyport, Wash. Quality Evaluation Lab.
IDENTIFICATION OF PLASTICS USED IN NAVAL ORDNANCE
S. B. Knapp and J. A. Arne 25 Aug. 1967 44 p refs
(QE/K-67-83; AD-658536)

Tests are described for identifying plastics found in Naval ordnance weapons. The tests require relatively simple procedures and equipment. Identification tests described are sensory, burning, chemical, and infrared spectroscopic tests. Typical spectrograms are included. Author (TAB)

N68-12869# Linden Labs., Inc., State College, Pa.
STRENGTHENING OXIDES BY REDUCTION OF CRYSTAL ANISOTROPY
Henry P. Kirchner and Robert M. Gruver Aug. 1967 69 p refs
(Contract N00014-66-C-0190)
(TR-1; AD-661469)

An investigation of the effect of crystal anisotropy on the strength of oxides is described. Solid solutions of various materials in rutile (TIO2) and zincite (ZNO) were prepared and the thermal expansion properties were measured in an attempt to find compositions with reduced anisotropy. Bodies composed of 72% AL203-28% CR203 were prepared by reactive hot pressing. Preliminary evidence of a strengthening effect compared with pure AL203 is presented. Author (TAB)

N68-12874*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PROCEDURES AND REQUIREMENTS FOR THE EVALUATION OF SPACECRAFT NONMETALLIC MATERIALS
Arthur F. Ringwood 5 Jun. 1967 124 p Revision A
(NASA-TM-X-60754; MSC-A-D-66-3, Rev. A) CFSTI: HC $3.00/MF$0.65 CSCL 11B

The more rigid requirements imposed on the selection and performance of Apollo spacecraft nonmetallic materials are presented, and the revised test procedures are detailed. These include tests on the upward and downward propagation rates, flash and fire point, electrical wire insulation and accessory flammability, electrical potting and coatings flammability, odor, carbon monoxide and offgassing products determinations, materials in vented containers, and electrical overload for hermetically sealed containers. Guidelines are included for simulated panel and assembly flammability tests, and for simulated crew bay configuration flammability verification tests. The supplementary tests described pertain to thermogravimetric analysis with spark ignition, and differential scanning calorimetry with spark ignition. The responsibilities and operation of the Manned Space Center Nonmetallic Materials Selection Review Board are delineated. M.G.J.

N68-12882# National Cash Register Co., Dayton, Ohio. Capsular Research and Product Development Dept.
DEVELOPMENT OF MULTIPURPOSE CAPSULAR ADHESIVE SYSTEMS
James C. Scott May 1967 65 p
(Contract DA-28-017-AMC-3215(A))
(AD-661313)

The objectives of the program were two-fold: select commercially available thermosetting adhesive systems and formulations that could be used as underwater adhesive systems; and demonstrate the feasibility of converting selected adhesive formulations to capsular adhesive systems thereby insuring improved versatility and logistic properties. As design goals, the selected capsular adhesive systems were required to meet the following requisites: Yield a cure time of 30 seconds or less; bond to both dry and wet (submerged) substrates of wood, metal, and concrete; and, yield a bond strength of 0.5 psi after a 30 second cure. Studies revealed that none of the commercially available systems met all of the contract requirements. Of the systems evaluated, the polysulfides and cyanoacrylates did meet more of the requirements than any of the other systems. Capsular adhesive systems possessing various design goal requirements were developed using the polysulfide, polyester, epoxy and cyanoacrylate systems. TAB

N68-12889* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
RECENT DEVELOPMENTS IN LOW-DENSITY ABLATORS
James N. Moss and William E. Howell 1967 14 p refs Presented at the 12th Natl. SAMPE Symp., Anaheim, Calif., 10–12 Oct. 1967
(NASA-TM-X-60755) CFSTI: $3.00 CSCL 11I

Results are presented of an experimental investigation of low-density (10- to 20-lbm/ft^3 or 160- to 320-kg/m^3) phenolic-nylon and elastomeric ablative composites. The ablative effectiveness of some of the low-density composites studied at a cold-wall heating rate of 20 Btu/ft^2-sec (0.23 MW/m^2) was found to be about 1.5 times that of the 36- to 40-lbm/ft^3 (580- to 640-kg/m^3) composites. The fabrication techniques used, oven and dielectric, are described in detail. Using the dielectric heating technique, it has been possible to reduce the cure time from 16 hours as required by oven heating techniques to less than 5 minutes without a reduction in ablative effectiveness. Analysis shows that reducing the ablator density from 36 to 10 lbm/ft^3 (580 to 160 kg/m^3) reduces the local heat-shield mass of a lifting-body entry vehicle by 52 percent. Author

N68-12914*# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.

FAILURE CRITERIA FOR VISCOELASTIC MATERIALS Semiannual Status Report, Sep. 1–Dec. 31, 1967

W. G. Knauss Dec. 1967 11 p refs

(Grant NsG-172-60)

(NASA-CR-91285; GALCIT-120; GALCIT-SM-67-12) CFSTI: $3.00 CSCL 11J

Crack propagation measurements were made in cracked strip specimens subjected to step straining, and indications are that crack propagation involves a time-dependent material degradation process which competes with the propagation rate. The possibility of correlating crack propagation in time-varying stress fields with crack propagation data in simple time histories of applied loads is pointed out. A penny-shaped crack with time-dependent properties was analyzed, using a stress distribution model which assumes finite stresses at the crack tip by incorporating a limiting yield or failure stress. The results are specialized to a number of time-dependent material properties. The rate of ligament rupture in elastomer foams was measured by recording the acoustic noise associated with it. It was noted that initially the rupture rate is high and then decreases in accordance with the rupture exhaustion theory of bond rupture in polymers. With the onset of general rupture, the rate increases presumably due to the local growth of a crack-like defect.

M.G.J.

N68-12985# Avco Corp., Lowell, Mass. Space Systems Div.

DEVELOPMENT AND EVALUATION OF TRANSPARENT ALUMINUM OXIDE Final Report, 1 Jul. 1966–30 Jun. 1967

William H. Rhodes, David J. Sellers, Arthur H. Hever, and Thomas Vasilos 30 Jun. 1967 72 p refs

(Contract N178-8986)

(AVSSD-0415-67-RR; AD-661487)

Polycrystalline Al_2O_3 possessing high total and in-line transmission in the visible range was prepared successfully by a combined high temperature hot forging and annealing operation. Transparency was found to be produced by a combination of several pore removal mechanisms active during deformation and primary recrystallization. A strong basal texture normal to the pressing direction was found for both deformation and recrystallization structures, and the high in-line transmission characteristics were thought to be due to a lowering of birefringent scattering because of this texture. Initial experiments were conducted to define the critical strain for recrystallization, and to date it is thought that this strain lies between 4 and 10 percent. Room and elevated temperature bend strengths of these materials were equivalent to opaque but dense pressure or pressureless sintered alumina having a comparable grain size. Author (TAB)

N68-13047*# General Electric Co., Philadelphia, Pa. Missile and Space Div.

STUDY OF ELASTOMERIC SHIELD MATERIALS (ESM) FOR APOLLO

5 Feb. 1963 132 p Prepared for NASA

(NASA-CR-91372; GE-RSD-N30122) CFSTI: HC $3.00/MF $0.65 CSCL 11J

In-house, flight test, and other evaluative data relating to the design and possible use of elastomeric shield materials (ESM) are reported, and results are included on a study for an ESM thermal shield for the Apollo command module. It is shown that ESM can be fabricated into a simple monolithic shield with superior thermal characteristics and mechanical properties. In addition to these advantages, the thermal shield fabricated of ESM exhibits resistance to service damage prior to launch or during flight; to ground environmental factors; to radiation and related space environmental factors, and to micrometeorite damage. The ESM shield exhibits density variability over a wide range, allows for the use of a high backfire temperature, and has a high heat of degradation. M.W.R.

N68-13077# Explosives Research and Development Establishment, Waltham Abbey (England).

THE ACCELERATED AGEING OF SOME COMMERCIAL POLYURETHANE RUBBERS

B. L. Hollingsworth, K. J. Ledbury, and A. L. Stokoe 18 Jan. 1967 15 p refs

(ERDE-21/M/66; AD-661499)

Nineteen commercial polyester urethane rubbers, and one commercial polyether urethane rubber were subjected to accelerated laboratory ageing for periods of up to two years under hot/dry, hot/wet, and hot/humid conditions, and for up to two years immersed in Standard Test Fluid. The results obtained on the polyether urethane were similar to those obtained in previous trials. The best polyester urethane (a development material) had a life under hydrolytic conditions of five to eight times that normally expected from commercially available polyester urethanes. Author (TAB)

N68-13106*# United Aircraft Corp., East Hartford, Conn. Research Labs.

INVESTIGATION OF THE KINETICS OF CRYSTALLIZATION OF MOLTEN BINARY AND TERNARY OXIDE SYSTEMS Quarterly Status Report, 1 Sep.–30 Nov. 1967

Jans F. Bacon, Robert B. Graf, and George K. Layden 1 Jan. 1968 38 p

(Contract NASw-1301)

(NASA-CR-91377; F910373-9; QSR-9) CFSTI: HC $3.00/MF $0.65 CSCL 11B

Direct microscopic observation of crystals growing in molten oxides has shown that both yttria and more particularly lanthana markedly decrease the rate of crystal growth in the cordierite field. This observation confirms the basic hypothesis that the likelihood of glass formation in a given system must be regarded as a rate phenomenon. Research to date in this laboratory has concentrated on learning how to attain the correct strength value for readily available commercial glasses. At this time we are able to measure a strength of 415,000 psi for E glass fibers prepared in our own laboratory in contrast to the published value of 530,000 psi for commercially produced glass fiber. Modulus measurements were carried out on ten additional glass compositions from which glass fibers could be made mechanically at high rates of speed as well as a repetition of one of the UARL higher modulus glasses, number 129. The original twenty samples tested from this glass had an average modulus of 16.5 million psi while twenty samples from a freshly prepared batch of the same glass averaged 16.9 million psi. Author

N68-13109# Explosives Research and Development Establishment, Waltham Abbey (England).

THE INFLUENCE OF ENVIRONMENT ON STATIC FATIGUE OF POLYMERS

D. Gordon 6 Jan. 1967 28 p refs

(ERDE-7/R/66; AD-661503)

The effects of several gaseous environments on the static fatigue of nylon 6.6 and atactic polystyrene filaments were studied. Considerable care was taken to reduce the influence of light, temperature fluctuation, vibration and contamination, all of which may affect the life of materials under stress. No statistically-significant difference in stress lives could be attributed to the environments studied, namely, humid air, dry air, dry nitrogen and vacuum for both materials at 30C and humid air, dry air and dry nitrogen at 50C for nylon. Author (TAB)

N68-13147* Lockheed-Georgia Co., Marietta. Nuclear Lab.

RADIATION EFFECTS ON COMPOSITE STRUCTURES

Apr. 1966 76 p

(Contract NAS8-20206)

(NASA-CR-91345; ER-8582) CFSTI: $3.00 CSCL 11D

The electrical breakdown of Mylar micrometeoroid detectors was studied under simulated space conditions to determine the

amplitude range of trapped electron breakdown pulses, a method of discriminating them from micrometeoroid produced pulses, and the temperature dependence of electron breakdown pulses. Pegasus panels, used as test specimens, were placed in a controlled temperature heat sink, with the electron source mounted inside the heat sink volume and parallel to the panels. The entire assembly was located in a large vacuum chamber held at approximately 10^{-6} torr. Temperature was varied and controlled from ambient to −90°F. Principal test results indicate: (1) Pulses were of both polarities with respect to the bias voltage of the panel. (2) Pulse rise time was on the order of microseconds. (3) Amplitude and polarity of breakdown pulses were apparently independent of bias or load resistance. (4) Breakdown rate varied approximately inversely with temperature, essentially vanishing at room temperature. (5) The spectrum of breakdown amplitudes decayed rapidly with amplitude, with no pulse observed greater than 2.7 volts. M.G.J.

N68-13201*# University of Southern Calif., Los Angeles.
[GLASS TRANSITION PHENOMENA] Semiannual Status Report
R. Simha 1 Dec. 1967 5 p
(Grant NsG-343)
(NASA-CR-91277) CFSTI: HC$3.00/MF$0.65 CSCL 11I

Multiple transitions in various polymer systems and related equation of state properties are discussed in connection with glass transition phenomena. Thermal expansivities between about 20 and 120°K were obtained for 10 polyalkyl methacrylates, poly 4-methyl pentene-1, a 49:51 ethylene–propylene copolymer, and several polyvinyl alkyl ethers. Overlap between liquid nitrogen and helium data leads to maximum discrepancies of about 20% for some of the polymers. The characteristic brittleness of these polymers is contrasted with their ability to undergo transitions or relaxations related to their side chains. M.W.R.

N68-13220# Picatinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center.
EFFECT OF LOW TEMPERATURE (0 TO −65°F) ON THE PROPERTIES OF PLASTICS
Joan B. Titus Jul. 1967 236 p refs
(PLASTEC-30; AD-661633) CFSTI: HC $3.00/MF $0.65

The effects of low temperature on the mechanical, electrical and thermal properties of plastics is discussed. Data are given where available at three temperatures; namely, low temperature, about -65F, room temperature and around 160F to permit complete evaluation. The material is presented by plastic family (in alphabetical order) and is divided into three parts: thermoplastics, thermosets and foams. Author (TAB)

N68-13362*# National Aeronautics and Space Administration, Washington, D. C.
THE PERMEABILITY OF PLASTIC FILMS AND FOILS TO GASES, VAPORS AND LIQUIDS [DE DOORLATENDHEID VAN KUNSTSTOFFILMS EN FOLIES VOOR GASSEN, DAMPEN EN VLOEISTOFFEN]
P. T. van Raaij and P. Winkel Jan. 1968 24 p refs Transl. into ENGLISH from RVO–TNO Rept.-1966-16 (Rijswijk), 1966 p 39
(NASA-TT-F-11325) CFSTI: HC$3.00/MF$0.65 CSCL 11I

The basic theories of the permeability of thin macromolecular films to small molecules are reviewed, with mathematical formulas and graphs on irradiated and nonirradiated polyethylene and cellophane permeability. Factors affecting permeation, such as temperature and pressure, chemical nature and geometry of diffusing substances and chemical nature and molecular structure of the polymer films are discussed. Laminates of paper/plastic and metal/plastic for special purposes, including protection from poison gases, are described briefly. Author

N68-13440# Monsanto Research Corp., St. Louis, Mo. Organic Chemicals Div.
TENSILE PROPERTIES OF PLASTICIZED PVC AS A FUNCTION OF PROCESSING
C. D. Bias, A. W. M. Coaker, and J. D. Hinchen Nov. 1967 21 p refs Presented at the 16th Ann. Wire and Cable Symp., Atlantic City, 29 Nov. 1967
(AD-661402)

A statistical study was made of the tensile properties of plasticized PVC as a function of processing variables and environmental exposure. For this purpose, the performance of three polyester plasticizers was studied in a typical 105C. wire-coating formulation. Tensile properties were measured before and after oven aging. It was found that it is possible to get spuriously high per cent retention of elongation by under-fusing this type of formulation. To prevent deliberate use of this phenomenon to make sub-standard formulations pass when they should fail, the specifications should be modified. Author (TAB)

N68-13453 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Flugzeugbau.
STRENGTH BEHAVIOR OF GLASS-REINFORCED PLASTIC LAMINATES PERPENDICULAR TO THE PLANE OF LAYERS [DAS FESTIGKEITSVERHALTEN GLASFASERVERSTAERKTER KUNSTSTOFFLAMINATE SENKRECHT ZUR LAGEREBENE]
G. Niederstadt May 1967 37 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-65) CFSTI: $3.00

Laminates of glassfibre reinforced plastics have excellent properties in the direction of the fibres. But only in tension these properties can be realized. As soon as laminates are subjected to shear stress failure will occur much earlier because of the poor adhesion between fibre and resin. This adhesion is investigated in this report. It was found out that there are many important effects which influence the adhesion. Especially the attack of water takes a strong effect. Not so much but nevertheless effective becomes the finish of the reinforcement and the glass content of the laminates. In some cases improved adhesion strength was determined after postcuring. It was found out that synthetic fibres are only useful if they are not derivatives from natural fibres. Author

N68-13499 Central Lab. TNO, Delft (Netherlands).
MECHANICAL PROPERTIES OF HIGHLY FILLED ELASTOMERS. 7: THE SHEAR MODULUS OF RUBBERS CONTAINING FILLERS WITH A BIMODAL SIZE DISTRIBUTION
Leendert C. E. Struik, Hendricus W. Bree, and Friedrich R. Schwarzl Nov. 1967 56 p refs
(Contract F6052-67-C-0059)
(ONR-TR-7; CL/67/113)

A polyurethane rubber was filled with a mixture of coarse and fine sodium chloride particles. The size of the coarse particles was about 250 μm, that of the fine particles about 35 μm. The mixing ratio of coarse to fine particles was varied systematically. The total content of filler ranged from 0 to 70% by volume. For these materials, the shear modulus was determined in the rubbery state, i.e. far above the glass–rubber transition temperature. The modulus depended on the total content of filler as well as on the mixing ratio of coarse to fine. A theoretical explanation is given. Author

N68-13510*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
A PRELIMINARY EVALUATION OF SILANE COUPLING AGENTS AS PRIMERS AND ADDITIVES IN POLYURETHANE BONDING PROCEDURES
L. M. Thompson and W. E. Hill [1967] 15 p
(NASA-TM-X-53676) CFSTI: HC$3.00/MF$0.65 CSCL 11I

Significantly improved strength retention at temperatures up to 200°F has been observed for polyurethane bonded joints in three bonding procedures where silane coupling agents were used as primers for metal adherends and in another procedure where a silane coupling agent was used as an additive to the resin system. Notable strength gains were also evident in bonds tested at cryogenic and ambient temperatures. Author

N68-13820* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECT OF SUBSTRATE STRUCTURE ON DEPOSITION OF EVAPORATED CARBON
D. B. Fischbach (Univ. Coll. of Swansea) [1967] 6 p refs
(Contract NAS7-100)
(NASA-CR-91501) CFSTI: $3.00 CSCL 11B

During tensile creep studies on pyrolytic and glassy carbons, carbon deposits built up on the exposed gage section surfaces of specimens during tests lasting several hours at temperatures ranging from 2700° to 2900°C. The tests were conducted in argon in a tubular resistance furnace with a single element of coke-pitch graphite. The surface deposits were adherent, differential thermal expansion stresses resulted in kink deformation of the specimen corners, and cracking and flaking of the deposit occurred upon cooling to room temperature. The deposits were found to have evaporated from the coke-pitch graphite heating element. The nucleation, growth, and adherence of the evaporated carbon films were found to be dependent on the nature of the substrate surface. The influence of chemical bonding at exposed layer-plane edge sites on deposit nucleation and adherence could account for most of the deposition phenomena observed. R.N.A.

N68-13865# Oak Ridge National Lab., Tenn.
PREPARATION OF MONOCRYSTALS OF CALCIUM OXIDE IN A PLASMA FURNACE
Francois Galtier and Robert Collongues 4 Jan. 1967 2 p refs
Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), Ser. C, v. 264, no. 87
(ORNL-TR-1807) CFSTI: HC $3.00/MF $0.65

Monocrystals of calcium oxide were prepared by the Verneuil method using plasma heating. The crystals are as large as 7 mm diameter and more than 20 mm long. They are perfectly transparent and show a remarkable inertia chemically. Author (NSA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-12870# Ballistic Research Labs., Aberdeen Proving Ground, Md.
FUNCTION APPROXIMATION BY A POLYGONAL CURVE
Clinton M. Frank and Ralph E. Shear Apr. 1967 27 p refs
(BRL-R-1363; AD-653140)

A dynamic programming formulation of least squares approximation of a function by continuous, piecewise linear functions is presented. Computation results include the determination of slopes and break points of the polygonal approximating curve. The results are useful for function generation on analog and digital computers. Author (TAB)

N68-12894# Florida State Univ., Tallahassee. Dept. of Statistics.
THE LIMITING DISTRIBUTION OF THE LIKELIHOOD RATIO STATISTIC UNDER A CLASS OF LOCAL ALTERNATIVES
Roger R. Davidson and William E. Lever Sep. 1967 60 p refs
(Contract Nonr-988(08))
(M126; ONR-TR-24; AD-661200)

The paper gives a proof that -21 n lambda sub n, the likelihood ratio statistic based on a sample of size n, converges in distribution to a noncentral chi-square distribution under local alternatives to the null hypothesis for a multi-dimensional parameter space. Consideration is limited to maximum likelihood estimates that are solutions to the likelihood equations obtained for the maximization process. Proof of uniform convergence for this situation has been given by Wald (Wald, A. (1943) Tests of statistical hypotheses concerning several parameters when the number of observations is large. Trans. Amer. Math. Soc. 54, 426–482.), whose assumptions include the uniform consistency of the maximum likelihood estimates and of the likelihood ratio test. The assumptions utilized in this paper can be more directly verified in applications than those required by Wald. Author (TAB)

N68-12903*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
METHODS FOR THE NUMERICAL SOLUTION OF DEGENERATE LINEAR AND NONLINEAR ELLIPTIC BOUNDARY VALUE PROBLEMS
Harold J. Kushner Nov. 1967 38 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67; NSF GK-967)
(NASA-CR-91294; TR-67-7) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Two distinct but related results are obtained. First an iterative method is derived for obtaining the solution of optimal control problems for Markov chains. Second, non-linear finite difference equations which approximate the nonlinear degenerate elliptic equation arising out of the stochastic optimization problem (for diffusion processes) are found. The difference equations, and their solution, may have a meaning for the control problem even when the elliptic equation for the cost is degenerate. The iterative methods for the iterative solution of these nonlinear systems are discussed and compared. Both converge to the solution, one often much faster than the other. In fact, the typical time required for the numerical solution is about the time required for a related linear problem. For a wide variety of nonlinear degenerate elliptic boundary value problems, the method yields a suitable set of nonlinear finite difference equations and implies that the associated iterative procedures converge. Author

N68-12915 Wisconsin Univ., Madison. Dept. of Statistics.
BAYESIAN ANALYSIS OF A THREE-COMPONENT HIERARCHICAL DESIGN MODEL
G. E. P. Box and G. C. Tiao Aug. 1966 37 p refs
(Grant NSF GS-549)
(TR-84; PB-173525)

The problem of making inference about the parameters in the three-component hierarchical design model is considered from a Bayesian viewpoint. Under the usual normality and independence assumptions and adopting a noninformative reference prior, various features of the posterior distribution of the variance components are discussed, including inferences about a variance ratio, the relative contributions of the components, and magnitude of the individual components. A scaled χ^2 approximation technique is developed for the marginal distributions of the components which can be applied to general q-component model. In addition, a Bayesian solution to the problem of pooling variance estimates is given. Author

N68-12932# California Univ., Berkeley. Operations Research Center.
MINIMAX RESULTS FOR IFRA SCALE ALTERNATIVES
Kjell Doksum Aug. 1967 29 p refs
(Contracts Nonr-222(83); Nonr-3656(18))
(ORC-67-31; AD-660376)

Let x sub 1, ..., x sub m and y sub 1, ..., y sub n be two independent random samples from populations with continuous ifra distributions f(.) and f(./delta) respectively, and let s sub 1, ..., s sub n denote the ranks of the y's in the combined sample. For testing h sub 0: delta = or < 1 vs. h sub 1 delta > 1 it is shown that the error probabilities of each monotone rank test phi are bounded by the error probabilities for exponential alternatives. Inequalities are used to derive tests that maximize the minimum power in the class of all rank tests. The results are extended to censored samples, sequential sampling, distributions ordered by skewness, the problem of combining independant test statistics, and the goodness of fit problem. Author (TAB)

N68-12935# Hebrew Univ., Jerusalem (Israel). Dept. of Mathematics.
EQUILIBRIUM POINTS FOR GAMES WITH INFINITELY MANY PLAYERS
Bezalel Peleg Dec. 1966 6 p refs
(Contract N62558-4355)
(RM-24; AD-646901) CFSTI: HC $3.00/MF $0.65

Conditions that guarantee the existence of equilibrium points for games with infinitely many players are discussed; essentially what is needed is that the payoff functions are continuous in an appropriate sense. If the continuity assumption does not hold then one shows by an example that equilibrium points may not exist. Author (TAB)

N68-12949# RAND Corp., Santa Monica, Calif.
AN INITIAL-VALUE METHOD FOR FREDHOLM INTEGRAL EQUATIONS WITH DEGENERATE KERNELS
H. H. Kagiwada, R. E. Kalaba, A. Schumitzky, and S. Ueno Nov. 1967 9 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5516-PR; AD-662009)

The final step in the mathematical treatment of many problems in such fields as radiative transfer, neutron transport, and optimal filtering theory involves the solution of a Fredholm integral equation in which the kernel is degenerate or can be closely approximated by a degenerate kernel. The standard procedure for solving such an equation is to convert it into an equivalent matrix equation and compute the solution by evaluating a number of integrals and performing a matrix inversion. This last step, however, can present serious computational difficulties. In this study, invariant imbedding techniques are used to convert the Fredholm equation into an initial-value problem, and the troublesome matrix inversion is replaced in this formulation by solving a Riccati system of differential equations. Author (TAB)

N68-12986# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
ON A CLASS OF LINEAR STOCHASTIC DIFFERENTIAL GAMES
R. D. Behn and Y. C. Ho Oct. 1967 48 p refs
(Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(TR-542; AD-661831)

The solution for a class of stochastic pursuit-evasion differential games between two linear dynamic systems is given. This class includes the classical interception game in euclidean space. The performance index which is optimized is quadratic, and one of the two players has imperfect (noisy) knowledge of the states of the two systems. The certainty-equivalence principle or, equivalently, the technique of separating the estimator and the controller which characterizes the standard stochastic control problem is shown to be applicable to this class of differential games. Author (TAB)

N68-13020 Technische Hochschule Munchen (West Germany). Fakultaet fuer Allgemeine Wissenschaften.
ON THE EFFICIENCY OF MATHEMATICAL METHODS IN ECONOMIC THEORY [UEBER DIE ERKENNTNISLEISTUNG MATHEMATISCHER METHODEN IN DER WIRTSCHAFTS-THEORIE]
Friedrich Hoesch (Ph.D. Thesis) [1967] 156 p refs In GERMAN

Details are given for the application of mathematical logic and statistical analysis in quantitative economic theory. The construction of various mathematical models expresses the complex relationships inside economic processes and helps management planning and decision making. Transl. by G.G.

N68-13026# Boeing Scientific Research Labs., Seattle, Wash.
SCALING OF MATRICES TO ACHIEVE SPECIFIED COLUMN AND ROW SUMS
Albert W. Marshall and Ingram Olkin Aug. 1967 18 p refs
Its Mathematical Note No. 526
(D1-82-0645; AD-661387)

If A is an n x n matrix with strictly positive elements, then according to a theorem of Sinkhorn, there exist diagonal matrices D sub 1 and D sub 2 with strictly positive diagonal elements such that D1AD2 is doubly stochastic. This note offers an alternative proof of a generalization due to Brualdi, Parter and Schneider, and independently to Sinkhorn and Knopp, who show that A need not be strictly positive, but only fully indecomposable. In addition, we show that the same scaling is possible (with D sub 1 = D sub 2) when A is strictly copositive, and also discuss related scaling for rectangular matrices. The proofs given show that D sub 1 and D sub 2 can be obtained as the solution of an appropriate extremal problem. The scaled matrix D1AD2 is of interest in connection with the problem of estimating the transition matrix of a Markov chain which is known to be doubly stochastic. The scaling may also be of interest as an aid in numerical computations. Author (TAB)

N68-13034# RAND Corp., Santa Monica, Calif.
DIRECT AND INVERSE PROBLEMS FOR INTEGRAL EQUATIONS VIA INITIAL-VALUE METHODS
H. H. Kagiwada and R. E. Kalaba Oct. 1967 40 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5447-PR; AD-661550)

A numerical scheme for solving integral equations which exploits the capability of modern computers to integrate systems of several hundred or several thousand simultaneous ordinary differential equations subject to known initial conditions. The scheme is based on the conversion of basic integral equations of transport theory into initial-value problems. Inverse problems, which involve estimating properties of the sources of the radiation field and the medium, given certain observations on the solution of the radiation field, are viewed as nonlinear multipoint boundary-value problems that can be solved numerically by a quasilinearization technique. Results of numerical experiments are included, as well as numerous references to other works on the subject. The study should be of particular interest to meteorologists, physicists, and numerical analysts. Author (TAB)

N68-13078# Research Analysis Corp., McLean, Va.
MINIMIZING STRUCTURED UNCONSTRAINED FUNCTIONS
Garth P. McCormick Oct. 1967 18 p refs Presented at the Meeting of the Operations Res. Soc. of Houston, Tex., 5 Nov. 1965
(Contract DA-44-188-ARO-1)
(RAC-TP-277; AD-661649)

For the general nonlinear programming problem (nonlinear constraints, nonlinear objective function) the difficulty of obtaining a solution is controlled by n, the number of problem variables. This is in contrast to linear programming (where nonnegativity requirements are always assumed), where m, the number of nontrivial

constraints, determines the size of the problems that can be handled and their speed of solution. This paper outlines in detail modifications to the sequential unconstrained minimization technique (SUMT) for nonlinear programming that expand the size of problems that it can solve to the limitations imposed by the special-case algorithms devised for them. In particular, the special cases of mathematical programming, i.e., linear, separable, and factorable, programming, will be described. Author (TAB)

N68-13217*# Harvard Univ., Cambridge, Mass. Engineering and Applied Physics Div.

A STOCHASTIC APPROXIMATION SCHEME WITH ACCELERATED CONVERGENCE PROPERTIES

P. M. Newbold Oct. 1967 20 p refs

(Grant NGR-22-007-068; Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)

(NASA-CR-91434; TR-545) CFSTI: HC $3.00/MF $0.65 CSCL 12A

An examination of the first order steepest descent method for minimizing deterministic functions leads to the specification of sufficient conditions assuring the convergence with probability one of a new stochastic approximation algorithm. The algorithm is interpreted as a stochastic descent method using a constant, as opposed to a continually decreasing step length. The crucial convergence condition is that the variance of the gradient should be zero as well as a minimum at the solution point. The rather narrow class of problems to which the new algorithm is applicable can be extended to include many useful problems by employing accelerator methods adapted from the field of Monte-Carlo techniques, both to satisfy the condition, and to accelerate convergence. Simple illustrative examples demonstrating the effectiveness of the new algorithm are presented. Author

N68-13264# RAND Corp., Santa Monica, Calif.

PROPER EFFICIENCY AND THE THEORY OF VECTOR MAXIMIZATION

Arthur M. Geoffrion Nov. 1967 28 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5454-PR; AD-661543)

The report discusses a redefinition of the fundamental concept of efficiency to eliminate certain anomalous situations. The resulting new definition, called proper efficiency, is related to the notion of proper efficiency introduced by Kuhn and Tucker in 1950. However, the present definition avoids some of the drawbacks inherent in the earlier one. A comprehensive theory of vector maximization is constructed using the new definition, with and without various constraint qualification, convexity, and differentiability assumptions. The theory includes as a special case the standard theory of nonlinear programming. Author (TAB)

N68-13269# System Development Corp., Santa Monica, Calif.

FURTHER RESULTS ON GENERALIZED PREDICTOR-CORRECTOR METHODS

Roy Danchick 28 Jul. 1967 28 p refs

(SDC-SP-2901/000/00; AD-661659)

The paper extends from k=4 to k=6 the existence of stable, maximal order (2k+2), multistep predictor-corrector methods described by Gragg and Stetter. The key motion utilized in our derivations is, similar to that described by Butcher, a quasi-Hermite Interpolating Polynomial, H, over the points 0,1,2,..., k-1, theta where k-1<theta<k. From this notion follows a new characterization, in turn, leads us to the development of an explicit corrector truncation error formula. Author (TAB)

N68-13276* Michigan Univ., Ann Arbor.

COMPUTER GENERATION OF ARBITRARY FUNCTIONS

L. E. Fogarty Aug. 1966 10 p refs

(Contract NASr-54(06))

(NASA-CR-91302) CFSTI: $3.00 CSCL 12A

In connection with the generation of an arbitrary specified output as a function of given input variables, a problem is considered in which a given data matrix represents the function for given values of *n* input variables and generates a continuous output that is determined by prescribed interpolation rules. Two schemes for generating functions of several variables are found to be practical, but with limitations. One scheme can theoretically produce data matrixes without errors, but may require a large amount of equipment; the other produces a series approximation of the data matrix which usually converges very rapidly, but requires precomputation to determine the terms of the series. The theory of one-dimensional interpolation series is discussed, and analog computer generation of the interpolation series is described. Generalized interpolation functions of order one and of two or more variables are determined. Two-dimensional interpolating functions, functions of more than two variables, and symmetrical functions are considered; as is the approximation of functions of several variables by means of one-dimensional functions. M.W.R.

N68-13301*# Rocketdyne, Canoga Park, Calif.

VARIABLE MESH MULTISTEP METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS

R. Van Wyk Sep. 1967 37 p refs

(Contract NAS7-470)

(NASA-CR-91341; RR-67-12) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A multistep predictor-corrector method for the numerical solution of ordinary differential equations is developed. The difference equations employed are generalizations, for the case of variable mesh spacing, of previous formulas requiring fixed step size. In addition to retaining the high local accuracy and convergence properties of the earlier methods, the variable mesh method is developed in a form conducive to the generation of effective criteria for the selection of subsequent step sizes in the step by step solution of differential equations. These criteria are based on considerations of truncation error, convergence of corrector iterations, and an extensive treatment of relative numerical stability. The algorithm has been tested extensively and compared with other methods. The results of the comparison favor the new method. Author

N68-13323 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LENINGRAD UNIVERSITY. HERALD. MATHEMATICS, MECHANICS AND ASTRONOMY SERIES, VOLUME 19, NO. 1, 1964

20 Apr. 1967 251 p refs Transl. into ENGLISH of Vestn. Leningr. Univ., Ser. Mat., Mekhan. i Astron. (Leningrad), v. 19, no. 1, 1964 p 1–176

(FTD-MT-65-356; TT-67-62872; AD-658392)

A series of articles on mathematics, mechanics, astronomy, and related topics is presented. For individual titles see N68-13324 to N68-13343.

N68-13324 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE BOUNDEDNESS OF SOLUTIONS OF ONE SYSTEM OF DIFFERENTIAL EQUATION OF THE THIRD ORDER [OB OGRANICHENNOSTI RESHENIY ODNOY SISTEMY DIFFERENTSIAL'NYKH URAVNENIY TRET'YEGO PO-YADKA]

Ye. S. Anitova *in its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 3–13 refs (See N68-13323 04-19)

The author has investigated the restricted nature of the solutions of a system of differential equations. Author

N68-13325 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONVERGENCE IN DISSIPATIVE SYSTEMS OF THE SECOND ORDER [KONVERGENTSIYA V DISSIPATIVNYKH SISTEMAKH VTOROGO PORYADKA]
Yu. N. Bibikov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 15–26 refs (See N68-13323 04-19)

Consideration is given to a system of two equations $dx/dt = ax + f_2(y) + P(t)$ and $dy/dt = f_1(x) + by + Q(t)$, in which the functions $f_1(x)$ and $f_2(y)$ are continuously differentiated and the functions P(t) and Q(t) are continuous and bounded. A second system, differing from the first only in that the nonlinearities are situated along the main diagonal is also investigated. Sufficient conditions for the convergence of all solutions to the periodic one are derived for both systems. An example of the use of the method presented is given, using the Cartwright–Littlewood equation. Author

N68-13326 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF A DISCRETE TWO-PERSON GAME WITH BLUFFING [RESHENIYE ODNOY DISKRETNOY IGRY DVUKH LITS S BLEFOM]
M. A. Genin *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 27–41 refs (See N68-13323 04-19)

A simplified version of the popular card game called "believe it or not" is shown to be essentially a zero sum, two person game with bluffing. Rules are formulated for the game and a description of the possible strategies is given for each player. Several special cases of the game are then considered and the optimal strategies and the probability of winning are determined for each player. The general case is also investigated. Asymptotic relationships are suggested which simplify the computations. Author

N68-13327 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVARIANTS OF ENTROPY TYPE OF AUTOMORPHISM OF LEBESGUE'S SPACE [INVARIANTY TIPA ENTROPII AVTOMORFIZMOV PROSTRANSTVA LEBEGA]
O. V. Guseva *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 43–48 refs (See N68-13323 04-19)

Certain nonlinear invariants of Lebesgue's space automorphisms are constructed. They are calculated for Bernoulli's automorphisms and they turn out, in this case to be entropy functions. Author

N68-13328 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ESTIMATION OF SPECTRAL FUNCTIONS OF ONE CLASS OF STATIONARY RANDOM SEQUENCES
I. A. Ibragimov and T. M. Tovstik *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 49–65 refs (See N68-13323 04-19)

A real stationary stochastic process with equally distributed random variables is considered. Statistical analysis of the unknown spectral function is used to prove related theorems. Author

N68-13329 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIMIT THEOREMS FOR LARGE DEVIATIONS WHEN CRAMER'S CONDITION IS BROKEN, 2 [PREDEL'NYYE TEOREMY DLYA BOL'SHIKH UKLONENIY PRI NARUSHENII USLOVIYA KRAMERS, 2]
V. V. Petrov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 67–84 refs (See N68-13323 04-19)

This article contains the proofs of a number of integral limit theorems for large deviations of sums of independent random quantities without the assumption that Cramer's condition is fulfilled. Author

N68-13331 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF NONLINEAR VIBRATIONS [K TEORII NELINEYNYKH KOLEBANIY]
G. I. Mel'nikov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 105–116 refs (See N68-13323 04-19)

The autonomous system of equations of perturbed motion is considered for the case when the roots of the characteristic equations of the corresponding linear system are all different. An approximate method of integrating this system in the neighborhood of the origin is then described, the stability of the motion is discussed and some error estimates are given. Author

N68-13338 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ONE CLASS OF SOLUTIONS OF BOUNDARY VALUE PROBLEMS FOR LINEAR ELLIPTIC EQUATIONS WITH THREE INDEPENDENTS IN AN UN-BOUNDED DOMAIN [OB ODNOM KLASSE RESHENIY KRAYEVYKH ZADACH DLYA LINEYNYKH ELLIPTICHESKIKH URAVNENIY S TREMYA NEZAVISIMYMI PEREMENNYMI V NEOGRANICHENNOY OBLASTI]
A. P. Oskolkov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 187–194 refs (See N68-13323 04-19)

The principal boundary value problems with homogeneous and inhomogeneous limited conditions at infinity are solved for linear elliptic partial differential equations whose coefficients are regular at infinity. Author

N68-13339 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF ONE CLASS OF FREDHOLM INTEGRAL EQUATIONS [RESHENIYA ODNOGO KLASSA INTEGRAL'-NYKH URAVNENIY FREDGOL'MA]
M. F. Ramonov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 195–199 ref (See N68-13323 04-19)

Methods are presented for solving Fredholm integral equations of the first and second kind. Author

N68-13340 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF ABSTRACT GALERKIN METHOD [K USTOYCHIVOSTI ABSTRAKTNOGO METODA GALERKINA]
B. A. Samokish *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 201–205 refs (See N68-13323 04-19)

Some estimates are given for the condition number of the Galerkin Matrix, based on the general theory of approximative methods of L. V. Kantorovitch. Author

N68-13341 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASYMPTOTIC BEHAVIOR OF VALUES OF BILINEAR FORMS, CONNECTED WITH DEGENERATE ELLIPTIC EQUATIONS [K ASIMPTOTIKE SOBSTVENNYKH ZNACHENIY BILINEYNYKH FORM, SVYAZANNYKH S VYROKHDAYUSHCHIMISYA ELLIPTICHESQIMI URAVNEMI-YAMI]
I. A. Solomeshch *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 207–211 refs (See N68-13323 04-19)

Asymptotic formulas are obtained for the eigenvalues of bilinear integral forms connected with degenerate elliptic equations. Author

N68-13383# Syracuse Univ., N. Y. Physics Dept.
ALGEBRAIC METHOD AND INFINITE COMPONENT WAVE EQUATIONS
A. Bohm Aug. 1967 49 p refs
(Contract AT(30-1)-3399)
(NYO-3399-125; SU-1206-125) CFSTI: HC $3.00/MF $0.65

The infinite component wave equation approach is presented in a way which exhibits its relation to the algebraic method. The Majorana case is described in full detail and an algebraic reformulation of it is given. The Nambu and Fronsdal equations are considered. Author (NSA)

N68-13415# Stanford Research Inst., Menlo Park, Calif.
SENSITIVITY TESTING
George W. Evans, II, Robert C. McCarthy, and J. Bryce Tysuer Oct. 1967 41 p refs Prepared for Inst. Res. Develop.

This report contains descriptions of: three methods for designing and analyzing a sensitivity test (binomial experiment), a selection rule for choosing the runs in the experiment, and a possible classification of physical problems that lend themselves to sensitivity testing. The report emphasizes the statistical considerations involved in sensitivity tests. Author

N68-13450* Stanford Univ., Calif.
A MARKOVIAN REPLACEMENT MODEL WITH A GENERALIZATION TO INCLUDE STOCKING
Sheldon M. Ross 18 Sep. 1967 33 p refs Sponsored by NASA
(Contract Nonr-225(53))
(NASA-CR-91505; TR-97) CFSTI: $3.00 CSCL 14A

The following model is considered: A machine is inspected at the beginning of discrete time periods and its operating state (condition) is determined. After each inspection a decision upon whether or not to replace the machine at the end of the period must be made. It is shown that under certain cost conditions and transition probabilities the optimal policy has a simple form. A generalization of the case where one is allowed to stock reserve machines is also given. Author

N68-13492 Technische Hochschule Munchen (West Germany). Fakultaet fuer Allgemeine Wissenschaften.
TRANSVECTOR RELATIONS IN METRIC SPACES OF CHARACTERISTIC TWO [TRANSVEKTIONSRELATIONEN IN METRISCHEN VEKTORRAEUMEN DER CHARAKTERISTIK ZWEI]
Karlhorst Meyer (Ph.D. Thesis) [1967] 58 p refs In GERMAN

The reflective relations in orthogonal groups are treated using a method which is independent of the body characteristics. Purpose of the work is to find the spinor norm at characteristic 2 for orthogonal transformations in semi-simple vector spaces from one of the reflective components of an orthogonal transformation. The transvection components of the orthogonal transformations with characteristic 2 are proven, and spinor norms of any given body of the characteristic 2 are defined. Transl. by K.W.

N68-13495# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
PROPERTIES OF GENERALIZED ROOT-LOCI [DIE EIGENSCHAFTEN VERALLGEMEINERTER WURZELORTS-KURVEN]
G. Grusbel and L. Schmieder Oct. 1967 24 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-88) CFSTI: HC $3.00/MF $0.65

In this paper generalized root-loci are introduced, which are generated by mapping the polar coordinate lines of the C-plane into the s-plane. C(s) is the system gain which is in its general form complex. By means of the theory of complex functions it is possible to easily derive the essential properties of the root-loci. Furthermore Schwarz's reflection principle can be applied to show that straight lines and circles can be root-loci if and only if the poles as well as the zeros lie symmetrically to these straight lines and circles. From this the symmetrical properties of the root-loci are derived. In addition to the known methods for constructing the root-loci graphically, a method is derived for the stepwise computation of root-loci. The step size is estimated by means of the curvature. The formula of Ur, giving the curvature in regular and simple breakaway points, is generalized. An illustrating example is given. Author

N68-13614*# Grumman Aircraft Engineering Corp., Bethpage, N. Y.
PARAMETERIZATION OF THE SET OF POSITIVE-DEFINITE MATRICES AND AN ALGORITHM FOR ITS GENERATION
D. Rothschild and G. R. Geiss Nov. 1967 18 p refs
(Contracts NAS2-4063; NAS8-20306)
(NASA-CR-61402; RM-386) CFSTI: HC $3.00/MF $0.65 CSCL 12A

In this memorandum, a numerical technique is presented for generating the elements of the set of n dimensional positive-definite, symmetric matrices, based on a particular choice of the parameters that describe the elements of the set. The method was developed as a necessary step in connection with an approach to the problem of estimating the domain of stability (determining the magnitude of disturbance for which errors will be reduced with time) for a class of nonlinear differential equations (e.g., an application is the attitude control system of the OAO). The technique is general and may be applied to any problem requiring this type of matrix, e.g., stability analyses, optimization, filtering, etc. An associated computer program is discussed. Author

N68-13626 Kansas Univ., Lawrence. Dept. of Mathematics.
INTRODUCTION TO THE THEORY OF STRUCTURED CATEGORIES
Charles Ehresmann (Paris Univ.) Jul. 1966 98 p refs
(Grant NSF G-17057)
(TR-10; PB-173287)

An introduction to the theory of structured categories is presented in which the following topics are discussed: ideas of structures and conventions; the defining sketch of a graph and of a multiplicative class; the idea of a quasi-multiplicative graph, a multiplicative graph, a category, and a groupoid; duality (products); structured categories; and structures of H^*-categories. S.C.W.

N68-13830* New York Univ., N. Y. Lab. for Electroscience Research.
A SOLUTION TO THE "HIDDEN-LINE" PROBLEM FOR COMPUTER-DRAWN POLYHEDRA
Philippe Loutrel Sep. 1967 101 p refs
(Grant NGR-33-016-038)
(NASA-CR-91359; TR-400-167) CFSTI: $3.00 CSCL 12A

In the hidden-line problem for computer-drawn polyhedra, a computer algorithm determines which edges or parts of edges of a polyhedron are visible from a given vantage point. The need for an efficient solution is critical for on-line CRT display applications. This thesis describes an edge classification scheme that eliminates at once most of the totally invisible edges. To test the remaining edges, called potentially visible edges, a starting point is chosen and the number of faces hiding this point is computed. This original order of invisibility is transmitted, with the proper modifications, to all the edges of a path originating at the starting point. A vertex test is introduced to compute the variations whenever new edges from a vertex are to be included in the path. The general hidden-line algorithm is directly extended to the case of a cluster of two or more polyhedra. It is shown that some simplifications can be made in the case where all polyhedra are convex. A

solution to an illumination problem is presented for a point source of light. Examples of computer-drawn polyhedra are included. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-12816# Navy Dept., Washington, D. C.
SOME RESULTS OF METEOROLOGICAL AND AEROLOGICAL INVESTIGATIONS IN ANTARCTICA DURING THE PERIOD 1956–1966 [NEKOTORYE REZULTATY METEOROLOGICHESKIKH I AEROLOGICHESKIKH ISSLEDOVANIY V ANTARKTIDE ZA PERIOD 1956–1966]
I. M. Dolgin 9 Oct. 1967 29 p refs Transl. into ENGLISH from Inform. Bull. of the Soviet Antarctic Expedition, no. 57, 1966 p 43–59
(Rept.-2466; AD-661184)

Aerometeorological observations in Antarctica are performed not only at the permanent meteorological stations, but also by mobile detachments. The full complex of meteorological observations was, in a number of cases, augmented by gradient observations and by measurements of the total ozone content. Measurements made provide an adequate basis for the development of a reliable climatic characteristic of the free atmosphere of Antarctica. Author (TAB)

N68-12877# Air Weather Service, Washington, D. C.
SUMMARIES OF PRESSURE, TEMPERATURE, AND DENSITY OVER CAPE KENNEDY AFS, INCLUDING PERIODIC DENSITY VARIATIONS
Edward V. Von Gohren Aug. 1967 35 p refs
(TR-197; AD-661979)

Summaries of ARCASONDE 1A meteorological rocket thermodynamic data are presented for Cape Kennedy AFS based on data acquired in 1964-1966. Extremes, means, and standard deviations as a function of month and season are shown for altitudes of 80,000 feet through 200,000 feet. The data are statistically treated to provide an estimate of seasonal, diurnal, and interdiurnal periodicities at 160,000 feet over Cape Kennedy AFS. A nomogram of the atmospheric density as a function of local time and month is presented. Author (TAB)

N68-12934 Chicago Univ., Ill. Dept. of Geophysical Sciences.
A SATELLITE METEOROLOGICAL STUDY OF EVAPORATION AND CLOUD FORMATION OVER THE WESTERN PACIFIC UNDER THE INFLUENCE OF THE WINTER MONSOON
Tetsuya Fujita and Kiyoshi Tsuchiya (Japan Meteorol. Agency) Sep. 1966 37 p refs
(Grants Cwb-WBG-34; NSF GF-179; GEO-4)
(SMRP-RP-55; PB-173800) CFSTI: $3.00

A study of the source regions of winter monsoon clouds in relation to orographic features revealed that the cloud-free paths and the off-shore distance of the initial clouds measured along streamlines are closely related to the height of the mountains and the intensity of the monsoon. The patterns of clouds after their formation are found to vary according to the vertical wind shear, changing from convection cells with weak shear to transverse bands with moderate shear and longitudinal bands with strong shear. Following the study of cloud formations, the uses of satellite and aerological data in estimating evaporation from the sea surface were explored. It was found that the water content of monsoon clouds is considerably smaller than what might be expected through adiabatic rising processes. The ratio of actual to adiabatic water content was estimated to be about 0.6 over the Sea of Japan and about 0.7 over the western Pacific under the influence of a strong winter monsoon. Author

N68-13033# National Meteorological Center, Suitland, Md.
THE AIR POLLUTION POTENTIAL FORECAST PROGRAM
John D. Stackpole Nov. 1967 10 p refs
(WBTM-NMC-43)

Air Pollution Potential (APP) is definable as a set of meteorological conditions conducive to the accumulation of atmospheric pollutants. The meteorological conditions considered are those that effect the dispersion of pollutants that typically may be emitted from myriad low level sources. The national APP forecasting program considers the occurrence of such conditions on the synoptic scale; i.e., over large areas. These poor dispersion conditions are generally associated with a stagnating anticyclone. We describe the particular numerical-objective and subjective means by which these high APP conditions are rapidly detected and forecast for purposes of preparing national APP forecasts. Author

N68-13045# World Meteorological Organization, Geneva (Switzerland).
WORLD WEATHER WATCH: THE PLAN AND IMPLEMENTATION PROGRAMME
May 1967 62 p

The World Weather Watch Plan adopted for the four year period, 1968–1971, by the Fifth World Meteorological Congress; and the Implementation Program, are presented. The global observing, data processing, and telecommunication systems are described. A list of suggested minimum additional upper air stations for the program is given. L.S.

N68-13072# Atmospheric Research and Development Corp., Kansas City, Mo.
THUNDERSTORM PENETRATIONS OF THE TROPOPAUSE. A CLIMATOLOGY AND A METHOD OF ESTIMATION Final Report, Aug. 1965–Jul. 1967
Michael J. Long Aug. 1967 87 p refs
(Contract AF 19(628)-5189)
(AFCRL-67-0471; AD-661598)

Data sources for radar measurement of thunderstorm penetrations of the tropopause level outside the United States are listed, and a climatology for North America is presented. Important features are a double maximum over central and southern United States, a decrease in penetrations around the great lakes, and a few penetrations north of 50 N. Although few penetrations were found outside North America, northeastern China is listed as the next most likely area for large numbers of penetrations. Two studies suggest that the sole use of low level moisture or the maximum amount of energy available to a storm will not be successful in estimating penetration amounts. An equation of the form Y-A(e to the power bX) was found to fit the cumulative distribution of penetrations at ten United States stations. A method of estimating the cumulative frequency distribution of penetrations based on a determination of the highest penetration and the above equation gave good results. A computer program is included which will determine the highest penetration likely from a sounding. Author (TAB)

N68-13296 Weather Bureau, Silver Spring, Md. Techniques Development Lab.
INTERIM REPORT ON SEA AND SWELL FORECASTING
N. A. Pore and W. S. Richardson Dec. 1967 26 p refs
(WBTM-TDL-13)

Techniques Development Laboratory work during the past year on sea and swell forecasting is summarized. The computer programs being adapted for operational use and the test forecasts for a five day period in May 1967 are described. Author

N68-13397# RAND Corp., Santa Monica, Calif.
MONSOONAL INFLUENCES ON WIND, RAIN, AND CLOUD THROUGHOUT SOUTHEAST ASIA: A STUDY COVERING THE PENINSULA AND THE ARCHIPELAGO
C. Schutz Oct. 1967 307 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5418-PR; AD-661373)

This represents a compilation of climatological data for Southeast Asia that shows the monsoonal influences on wind, rain, and cloudiness in a synoptic pattern of the region. The compilation provides a base for understanding the weather in Southeast Asia and for developing empirical forecasting rules. Many similarities to weather observed in the United States are noted, since, as in the United States, large areas of Southeast Asia are affected by polar continental and tropical maritime air masses. Maps show general circulation and daily cloud conditions for winter and summer, and precipitation for all four seasons. Taken together, they relate the major broad-scale variations of these parameters throughout tropical Southeast Asia seasonally and give a cursory understanding of the forecasting problems. TAB

N68-13455 Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany).
INFRARED SPECTROSCOPY AS TOOL AND OBJECT OF METEOROLOGICAL AND PLANETARY RESEARCH [INFRAOTSPEKTROSKOPIE ALS HILFSMITTEL UND GEGENSTAND METEOROLOGISCHER UND PLANETARISCHER FORSCHUNG]
H.-J. Bolle (Munchen Univ.) Jul. 1967 324 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-17) CFSTI: $3.00

In this paper the structure of the infrared atmospheric spectrum is investigated and a procedure developed to compute spectral radiances of planetary atmospheres. The basic data of these calculations are proved by comparison with measured spectra. For water vapor continuum absorption coefficients and line intensities are derived from emission spectra obtained at the ground. The computer program is capable for the computation of transmission and emission spectra as well as spectral heating rates. It can be accounted for the superposition of different atmospheric constituents. The radiation transfer within single lines is considered in detail. Possibilities are discussed to derive atmospheric parameters from analysis of its infrared spectra. Examples are given for the earth and planet Mars. Author

N68-13605# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
DATA REDUCTION TECHNIQUES FOR USE ON METEOROLOGICAL DATA ABOVE 30 KILOMETERS
E. P. Avara and B. T. Miers *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 627–635 refs (See N68-13581 04-31)

The FPS-16 tracking systems superimpose undesired oscillations on the real position data, resulting in rapidly fluctuating successive position points which are physically unrealistic. A linear digital filter is applied separately to each component to smooth the data. The frequency response is given, and the data are corrected by a method derived by Eddy et al (1965). Atmospheric temperature is measured by use of the STS rocketsonde, and pressure and density are calculated from these data using hydrostatic and state equations. Author

N68-13740 European Atomic Energy Community, Ispra (Italy).
MULTIANNUAL STATISTICS OF THE METEOROLOGICAL OBSERVATIONS AT ISPRA (1959–1966) [STATISTICA PLURIENNALE DELLE OSSERVAZIONI METEOROLOGICHE AD ISPRA (1959–1966)]
G. Bollini Brussels Sep. 1967 97 p refs In ITALIAN; ENGLISH summary
(EUR-3569.I)

The mean and extreme values, made over a period of eight years at Meteorological Observatory near Ispra, are combined into 27 tables at 21 graphs for the following elements: temperature, humidity, sunshine and solar radiation, precipitation, pressure, wind and some other observations. The purpose of this work is to present a climatological base for the requirements of the Joint Nuclear Research Center, while detailed safety analyses are reported on the monographies, enumerated after the index. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-12948 Airborne Instruments Lab., Deer Park, N. Y.
SEAL CONTROL, DISPLAY AND RECORDING CONSOLE Final Report
J. P. Bethel Oct. 1967 121 p
(Contract FA-65-WA-1382)
(SRDS-RD-67-22) CFSTI: $3.00

A feasibility model control, display, and recording console was designed to be integrated with other feasibility models of special navigation receivers and an inertial positioning system to form the first Signal Evaluation Airborne Laboratory flight-inspection system. This airborne system is intended for inflight site-evaluation, commissioning, fault diagnosis, post-accident investigation and post-modification verification of VOR, TACAN, VORTAC and ILS navigation-aid facilities, plus the periodic inspection of the latter. The new system will have a more efficient, accurate and comprehensive measurement, display, and recording capability than the basic flight-inspection system now in use. The console is the heart of the SEAL system. From it the flight inspector controls the system and selects data from the various receivers and the positioning system for processing, display and recording. The principal display and recording device is a direct-writing strip-chart recorder. Author

N68-13081 Royal Aircraft Establishment, Farnborough (England).
SIMULATION OF A LINEARISED OPTIMUM GUIDANCE LAW FOR SPACE VEHICLE INJECTION, WITH APPLICATION TO THE ELDO VEHICLE
Keith Smith and R. Clarke Dec. 1966 60 p refs
(RAE-TR-66398; AD-660616)

An approximate guidance law for space vehicle injection guidance was studied by means of a digital simulation, using injection of the ELDO launcher into a 300 nm circular orbit as an example. The simulation was restricted to the third stage of flight and to two dimensions. The guidance law is based on continuous re-optimisation of the boost trajectory using measured values of vehicle state (position and velocity) as initial conditions. The approximation introduced corresponds to evaluating solutions which

are considered as small departures from a pre-calculated reference or nominal trajectory. The results of the simulation lead to the conclusion that the approximate solution yields adequate guidance performance over a realistic range of vehicle perturbations. Author (TAB)

N68-13132*# General Electric Co., Syracuse, N. Y. Special Information Products Dept.

MODULATION TECHNIQUES FOR RANGE MEASUREMENTS FROM SATELLITES Final Report

Jun. 1967 223 p refs

(Contract NAS12-146)

(NASA-CR-86017; ERC/R&D-66-1017) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Position fixing by range measurements from two or more satellites is considered in a study of modulation techniques, as is the measurement of range by finding the propagation time of a radio frequency signal from the satellite to the user craft and return. The accuracy of the range measurement does not depend upon the modulation technique used. Requirements, constraints, and parameters are discussed for single pulse amplitude modulation, multiple pulse train ranging, and side tone modulation. A single pulse ranging technique is presented for comparison of the various modulation techniques; and a power budget table and graph are included to show the satellite to user path transmitter power required for range measurements over a wide range of frequencies and system parameter values. A multiple access approach for a large number of users is considered, as are the properties and applications of pulse trains. Summaries are presented of evaluations of FM pulse compression, FM–CW triangular modulation, and pseudorandom code techniques. M.W.R.

N68-13140 Royal Aircraft Establishment, Farnborough (England).

A REVIEW OF THE EVIDENCE ON THE TRACK-KEEPING PERFORMANCE OF JETS IN THE NORTH ATLANTIC REGION IN THE PERIOD 1965–1966

R. G. Anderson Sep. 1966 21 p refs

(RAE-TR-66295)

Results are given for four recent data collections in 1965/1966 which give evidence on the navigation accuracy in the North Atlantic region. These are compared with earlier measurements and explanations are offered for some of the discrepancies between the data from the various sources. Author

N68-13158 Federal Aviation Agency, Atlantic City, N. J. Test and Evaluation Div.

ATC CONCEPTS FOR SUPERSONIC VEHICLES. PART 2-2 Interim Report

Andrew L. Sluka Nov. 1967 76 p ref

(RD-67-47, Pt. 2-2)

This report describes the Air Traffic Control (ATC) aspect of a dynamic simulation study which is part of a joint FAA and NASA simulation program to determine what impact the Supersonic Transport (SST) will have on the ATC System, as well as the ATC System impact on the SSTs operating characteristics. The simulation study conducted at the National Aviation Facilities Experimental Center (AFEC), investigated domestic and oceanic SST operations to and from Los Angeles and San Francisco International Airports in a simulated alpha numerics system representing a 1970 ATC environment. The NASA supersonic flight simulator at Hampton, Virginia, and the NAFEC ATC simulator were conjoined to provide performance and handling characteristics of a Boeing 2707 domestic and oceanic configuration. Results showed that one-way tracks are essential in nonradar environments when conditions require expeditious descent of SSTs to lower altitudes. Straight route segments for unrestricted SST transonic acceleration will on occasion necessitate vectoring or rerouting of subsonic aircraft to avoid these areas. Author

N68-13240# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.

FEASIBILITY STUDY OF A STAR SENSOR WITH DIGITAL OUTPUT SUITABLE FOR THE L.A.S.

A. Bastos and R. Collette Paris ESRO Jan. 1967 11 p

(ESRO-TM(P)-95) CFSTI: HC $3.00/MF $0.65

The last studies about the L.A.S. (Large Astronomical Satellite) control system consider the use of digital electronics as a good approach. Most of the star sensors have an analog output and an analog-to-digital converter is required if they are to be used in a digital L.A.S. control system. To try to avoid such a converter, thus increasing the reliability of the overall system and reducing the weights, a star sensor with digital output is considered here and the specifications of a feasibility study of such a sensor suitable for the L.A.S. are listed. Comments are given on total and linear field of view, on input light and output signals. Finally the upper and lower limits of the star presence signal were chosen as a reasonable approach but further studies may recommend a change. Author (ESRO)

N68-13287# Systems Technology, Inc., Hawthorne, Calif.

ANALYSIS OF DISPLAY-PILOT-VEHICLE DYNAMICS FOR ILS APPROACH OF A LARGE JET AIRCRAFT

W. F. Clement, J. J. Best, and R. L. Stapleford 27 May 1967 142 p refs

(Contract N00014-66-C-0072)

(TM-163-C; AD-661855)

Multiloop pilot/vehicle analysis forms the foundation of a rational procedure for synthesizing manual control/display systems. The theory for manual control displays is applied to the instrument landing approach of a large subsonic jet transport and a methodical display design procedure is presented. Manual approach path and lateral position control are treated in multiloop dynamic analyses so as to select preferred variables for measurement and display. Analytically derived performance and pilot workload measures are compared with allowable norms. The example concludes with the prediction of two preferred display arrangements. The predicted arrangements are then compared with FAA Category II instrument panel arrangement selected by two airlines operating the example aircraft. The predictions are shown to be remarkably accurate. Author (TAB)

N68-13515* Control Data Corp., Minneapolis, Minn. Aerospace Research Dept.

BREADBOARD DESIGN OF SCANNING CELESTIAL ATTITUDE DETERMINATION SYSTEM (SCADS) Final Report

A. J. Mooers, D. F. Nickel, R. D. Willey, and L. D. Kane 2 Nov. 1966 415 p refs

(Contract NAS5-9861)

(NASA-CR-91532) CFSTI: $3.00 CSCL 17G

The design, fabrication, laboratory and field testing of an optical celestial scanning device are described. A 46 degree field of view, f/0.95 lens, with an aperture of 2.1 inches collects the light which is scanned by a single rotating reticle slit through which star transits are detected by a photomultiplier. Stars as dim as 3.5 to 4.0 magnitude were repeatedly detected and identified. The results are given for the tests of this system for determining attitude (pointing direction), and azimuth using this sensor and a high speed digital computer to an accuracy of 0.1 degree under various modes of simulated satellite motion and various reticle slit widths and scanning periods. Even under the adverse Earth conditions of starlight scintillation and large background radiation this accuracy was achieved for all operational modes and for scanning periods as rapid as two seconds. Under many conditions an accuracy of 0.01 degree was obtained. These results were achieved through the use of a completely automatic star pattern recognition technique based on geometric data stored in the computer memory. Author

N68-13558* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

NAVIGATOR PERFORMANCE USING A HAND-HELD SEXTANT TO MEASURE THE ANGLE BETWEEN A MOVING FLASHING LIGHT AND A SIMULATED STAR

Bedford A. Lampkin Washington Jan. 1968 41 p refs

(NASA-TN-D-4174) CFSTI: $3.00 17G

The performance of a navigator using a hand-held sextant was investigated. The primary variables were the rate of angular motion of the flashing light and the frequency and on time characteristics of the flashing light. Performance criteria were the standard deviation of the measurement data and the bias of the measured angle compared to the true angle. Measurements were made from a stationary sighting station and from a sighting station simulating spacecraft oscillatory motion. An effective technique was developed for training navigators to measure accurately with a sextant. This technique uses measurement error feedback to the operator subsequent to each measurement to inform him of his error and to aid him in improving his subsequent measurements. The performance during this experiment indicates that an experienced navigator using a hand-held sextant during rendezvous navigation may obtain data with an accuracy of better than 60 arc seconds. Author

N68-13628# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

FINAL VALUE OPTIMIZATION OF SYSTEMS WITH BOUNDED CONTROLLER AND NOISY MEASUREMENTS

A. Van Gelder Nov. 1967 33 p refs

(RE-309)

A simplified version of the mid-course guidance problem for a space vehicle with a low-thrust control rocket is posed as a stochastic optimal control problem. The control decision process is continuous in time. Control magnitude is bounded in instantaneous value and in integrated value. The state of the system is observed in noisy measurements and governed by linear dynamics. Numerical solutions are generated by a procedure based on dynamic programming and are checked by a Monte Carlo simulation. Numerical solutions of a related problem, analyzed by Striebel and Breakwell, are also generated and the two are compared. Author

N68-13657 Royal Aircraft Establishment, Farnborough (England).

AN INVESTIGATION OF THE LATERAL CONTROL EQUATIONS FOR AUTOMATIC LANDING

J. D. Asteraki Dec. 1966 58 p refs

(RAE-TR-66401)

Using an analog computer, suitable control equations were searched for the basic autopilot and the maneuver-command computer when a localizer is used as the azimuth guidance system. For optimum landing performance, the equations of the basic autopilot should vary from one aircraft type to another, the degree of complexity depending on the aerodynamic characteristics of the aircraft. It was not possible to obtain good lateral performance with an automatic landing system by the correct choice of maneuver-command computer alone. The basic autopilot design has such a strong effect on the flight path after a disturbance that it must be tailored to the aircraft type if the best performance is to be achieved. K.W.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-12835 Joint Publications Research Service, Washington, D. C.

SYMPOSIUM ON NEUTRON THERMALIZATION AND REACTOR SPECTRA, IAEA [SIMPOYIUM PO TERMALIZATSII NEYTRONOV I REAKTORNYM SPEKTRAM]

12 Dec. 1967 225 p refs Transl. into ENGLISH from Papers Presented at Symp. held, Ann Arbor, Mich., 17–21 Jul. 1967

(JPRS-43682) CFSTI: $3.00

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N68-12836 Joint Publications Research Service, Washington, D. C.

AVERAGE NEUTRON DENSITY IN NONHOMOGENEOUS MEDIA

A. V. Stepanov *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 1–42 refs (See N68-12835 04-22)

The passage of neutrons through nonhomogeneous media which may be described by means of Boltzmann equation with fluctuating parameters has been investigated. An approximate equation for the neutron flow averaged over the fluctuations within the medium and applicable in the case of a small magnitude of fluctuations has been derived. The analysis of the time and energy dependence of the average of the neutron flow has been carried out. The analytical expressions for the relaxation constants of the neutron distribution have been found. The periodic reactor lattice has been investigated as an example of a nonhomogeneous medium. Author

N68-12837 Joint Publications Research Service, Washington, D. C.

METHODS OF SOLVING PROBLEMS IN NEUTRON THERMALIZATION THEORY

L. V. Mayorov and G. Ya. Trukhanov *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 43–62 refs (See N68-12835 04-22)

The possibilities of using a priori information concerning the general properties of the kinetic equation are examined in relation to its application in solving problems of neutron thermalization theory. The calculation of thermal neutron spectra in an infinite medium is given to show how the convergence of ordinary iteration methods can be speeded up by using a priori data on the spectrum. Attention is also focused on a technique for generalizing the integral balance method, with the plane symmetry problem used as an example. The method is considered attractive due to the possibility of unifying the ordinary universal iteration methods with the semianalytical methods of solutions and the results of physical analysis of the kinetic equation of the thermalization theory. A safety principle is formulated in an attempt to carry out this program. Variational principles for the kinetic thermalization equation are also developed and generalized to the case of multivelocity problems. M.G.J.

N68-12838 Joint Publications Research Service, Washington, D. C.

ANISOTROPY OF NEUTRON SPECTRA IN WATER NEAR AN ABSORBENT

S. N. Ishmayev, G. F. Liman, L. V. Mayorov, I. P. Sadikov, A. A. Chernyshov et al *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 63–80 refs (See N68-12835 04-22)

Measurements of the spatial-energy-angular distribution of neutrons in water near a plane cadmium surface have been carried out on an experimental device mounted on a linear accelerator. The methodology of measurements of stationary neutron spectra, by means of a chopper whose rotation is in phase with the start of the accelerator, is described. The results of the measurements of spatial dependence of the spectra of neutrons moving in two opposite directions from the absorber and towards the absorber, show that there exists a strong spectral anisotropy of neutrons near the absorbing surface. The numerical solutions of the kinetic equation (using the Nelkin model for water) yielded the angular spatial-energy distribution of neutrons which is then compared with experimental data. The influence of the moderator model and the neutron scattering anisotropy in water on the result has been analyzed. Author

N68-12839 Joint Publications Research Service, Washington, D. C.

A STUDY OF INELASTIC SCATTERING OF NEUTRONS IN GRAPHITE FOR VARIOUS TEMPERATURES

I. P. Yeremeyev, V. I. Mostovoy, I. P. Sadikov, M. N. Severov, and A. A. Chernyshov *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 81–105 refs (See N68-12835 04-22)

The results of the measurement of double differential cross sections of neutron scattering in reactor graphite at temperatures of 15°, 490°, 1,000°, and 1,370°C are presented. The measurements were carried out at the VVP-M reactor on an experimental device designed for the study of inelastic scattering of slow neutrons. The monochromatization and chopping of the primary beam of neutrons are carried out by means of a monocrystal and a mechanical chopper. The scattered radiation is analyzed by energies by the time of flight method which is carried out simultaneously at 8 angles within the 10° to 115° interval. The data are presented in the form of scattering cross sections which are compared with theoretical results obtained on the basis of the frequency spectrum proposed by Egelstaff. Author

N68-12840 Joint Publications Research Service, Washington, D. C.

A THEORY OF DENSITY DAMPING OF NEUTRONS FROM A PULSE SOURCE IN A CONFINED MODERATOR

M. V. Kazarnovskiy, L. V. Mayorov, and M. S. Yudkovich *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 106–122 refs (See N68-12835 04-22)

A method is described for calculating neutron distributions, and for determining the neutron spectra for arbitrary times. In general, estimates are established of the time at which the neutron filling of the low velocity range begins to show effects. The computer program using this method is briefly described, and results of the numerical calculations for the case of beryllium are presented. It is concluded that the time dependence analysis of neutron distribution from a pulsed source within confined moderators permits the determination of such a dependence for real moderators and arbitrary intervals of time. M.G.J.

N68-12841 Joint Publications Research Service, Washington, D. C.

NEUTRON SPECTRA IN A TWO-REGION GRAPHITE–WATER SYSTEM

Kh. Sh. Abdullayev, V. I. Bryzgalov, V. S. Dikarev, G. F. Liman, L. V. Mayorov et al *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 123–136 refs (See N68-12835 04-22)

Experiments were conducted to determine the spatial energy distribution of thermal neutrons in a graphite–water system in the presence of a temperature discontinuity between graphite and water. Measurements and calculations were made in the region of lower graphite temperatures (133°K) and somewhat higher temperature of water (343°K). The theoretical analysis consisted of (1) the solution of the one-dimensional kinetic equation describing the neutron thermalization within an idealized system in which the dimensions of the water tank (over the cross section) and of the graphite prism were equal, and (2) the solution of the diffusion thermalization equation in the two-dimensional geometry. The data obtained indicate that the calculated temperature relaxation lengths of neutrons are in good agreement with the experimental values. M.G.J.

N68-12842 Joint Publications Research Service, Washington, D. C.

USE OF SYSTEMS OF LAGUERRE POLYNOMIALS AND ASSOCIATED FUNCTIONS FOR THE SOLUTION OF CERTAIN THERMALIZATION PROBLEMS

N. I. Laletin and I. G. Pasynkov *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 137–149 refs (See N68-12835 04-22)

Several examples are presented to illustrate how the system of Laguerre polynomials can be complemented by a system of associated functions to determine the expansion coefficient. Various approaches are assessed and their shortcomings are discussed. A general system of equations is derived and applied to solving the problem of determining the neutron spectrum $\phi(E)$ where E is the energy measured in the units of kT, with k the Boltzmann constant, and T the temperature of the medium. M.G.J.

N68-12843 Joint Publications Research Service, Washington, D. C.

FINDING SOLUTIONS TO CERTAIN TRANSFER PROBLEMS

V. I. Lebedev *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 150–164 refs (See N68-12835 04-11)

Algorithms are presented and equations are derived, based on the KP-method, to solve multigroup transfer problems. It is pointed out that the number of unknown values of the functions in the systems of difference equations is so large that during the

solution of these systems by iteration methods all the unknowns obtained during one iteration step cannot be remembered. In the technique proposed, such rapidly converging iteration methods are developed so that the memorization of all the information concerning the solution is not required at each iteration step, but only a part of a substantially smaller dimensionality. Several examples are given to illustrate the problem solving technique. M.G.J.

N68-12844 Joint Publications Research Service, Washington, D. C.

STUDY OF NEUTRON THERMALIZATION IN WATER AT DIFFERENT TIMES

S. N. Ishmayev, V. I. Mostovoy, I. P. Sadikov, L. A. Tolmachevs, and A. A. Chernyshov *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 165–178 refs (See N68-12835 04-22)

Improved experimental apparatus and methodology are discussed in relation to their use in studying the processes leading to the establishment of the equilibrium spectrum of neutrons in time within a large water system near an almost point-pulsed source of fast neutrons. The influence of neutron diffusion on the thermalization process during the total time needed for establishing the equilibrium spectrum at various distances from the source was also investigated. The findings indicate: (1) Despite the considerable influence due to diffusion on the time behavior of the neutron density originating from a point source, the neutron thermalization process in water proceeds so intensely that the shape of the energy distribution does not, for all practical purposes, depend on the spatial coordinate within the region being studied. Consequently, the change of the neutron spectra in time under these conditions does not differ much from the case of an infinite medium with uniformly distributed sources. (2) The general pattern of neutron energy spectrum changes in water during time intervals from 5 to 300 μ sec confirm that the establishment of equilibrium energy distribution of neutrons in water requires a time exceeding 100 μ sec. M.G.J.

N68-12845 Joint Publications Research Service, Washington, D. C.

MEASUREMENT OF NEUTRON PULSE DROP IN SMALL SLUGS OF BERYLLIUM AND BERYLLIUM OXIDE

I. F. Zhezherun *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 179–198 refs (See N68-12835 04-22)

An assessment is made of the discrepancies found in various theoretical research on the spectrum of eigenvalues of the Boltzmann equation describing the behavior of neutron densities in small moderator slugs generated by pulsed source of neutrons. Details are given on additional measurements of the neutron pulse drop in small slugs of beryllium and beryllium oxide with geometrical parameters B^2 close or larger than the limiting value B^2_{lim}. The results show: (1) The drop in the neutron pulse of these slugs, observed over durations of not less than four decades, follows the exponential law almost exactly. (2) Very small deviations from the exponential law can be observed only above the physical λ k. M.G.J.

N68-12846 Joint Publications Research Service, Washington, D. C.

PF-4 EXPERIMENTAL EQUIPMENT FOR STUDYING NEUTRON ENERGY SPECTRA

V. A. Kuznetsov, A. I. Mogil'ner, M. Ya. Bankrashkova, I. I. Zakharkin, G. A. Ilyasova, et al *In its* Symp. on Neutron Thermalization and Reactor Spectra, IAEA 12 Dec. 1967 p 199–222 refs (See N68-12835 04-22)

Details are given on the experimental apparatus (PF-4 stand) constructed to study the spectral characteristics of a large number of critical and subcritical systems with thermal and intermediate-acting spectra. The PF-4 stand uses uranium 90% enriched in isotope 235 as the fissionable material. Two horizontal channels are located perpendicular to each other: one introduces the ionoduct of the pulsed source; the other extracts the neutron beam towards the flight basis of the time-of-flight spectrometer. Measurements were made of the neutron spectra in hydrogen-containing media, and of slow neutrons in a beryllium reflector of a fast reactor. The experimental results are compared with multigroup calculations. Measurement results are also presented on the integral characteristics of spectra in multiplying media from neutron pulse propagation. M.G.J.

N68-12866 United Kingdom Atomic Energy Authority, Risley (England).

MEASUREMENT OF FUEL RATING BY GAMMA SCAN AND WIRE ACTIVATION METHODS

F. G. Brightman and J. F. Norbury 1967 20 p refs (TRG-1464(W))

The choice of fission product for observation by gamma scanning is discussed, and the use of the $^{140}Ba/La$ pair is described. An account is given of errors arising in the Windscale advanced gas-cooled reactor (WAGR) measurements, and it is shown that relative rating measurements may be made at a point with an error of about 3-1/2%. Absolute point values are obtainable to $\pm$6-1/2%; efforts are being made to improve this. An outline is given of developments of the technique to measure rating distribution on complete stringers of fuel, by observations of very short-lived products such as ^{142}La. The indirect determination of rating distribution by activation of stainless steel wires in WAGR channels is described, and the measurement of ^{55}Mn and ^{50}Cr reaction rates is discussed. The errors are listed, and some comment is made on their variation with quantity measured. Absolute values of point rating are currently measured by this method to $\pm$7%. Possible developments are mentioned, leading to improved accuracy on both relative and absolute scales. Author

N68-12884# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CRITICAL EXPERIMENTS WITH ORGANIC MODERATORS—MONOISOPROPYL DIPHENYL AND GAS OIL [KRITICHESKIYE OPYTY S ORGANICHESKIMI YAMEDLITELYAMI-MONOIZOPROPILDIFENILOM I GAZOYLEM]

Yu. N. Aleksenko, V. I. Buynitskaya, V. V. Zaslavskiy, N. V. Zvonov, and V. N. Kozlov 3 May 1967 15 p Transl. into ENGLISH from Issled. po Primeneniyu Organ. Teplonositeley Zamedliteley v Energ. Reaktorakh (USSR), 1964 p 182–193 (Contract AF 33(657)-16410) (FTD-HT-66-746; TT-67-63251; AD-660438)

The article presents the results of critical tests on the organic moderators isopropylbiphenyl and gas oil, a description of an experimental "organic reactor," and some results of measurements carried out on this reactor. Graphs are included showing the distribution of thermal neutrons for different values of lattice spacing, the calculated dependence of the effective addition for gas oil and monoisopropylbiphenyl, the dependence of the critical number of channels for monoisopropylbiphenyl on the lattice spacing and for gas oil on both the temperature and lattice spacing, as well as the calculated values of the square length of moderation for biphenyl, monoisopropylbiphenyl, and gas oil. It is concluded that the physical experiments with critical assemblies carried out on monoisopropylbiphenyl and gas oil have made it possible to verify the method and system of constants used for calculating the physical characteristics of reactors with organic heat-transfer agents. Author (TAB)

N68-12919 Naval Research Lab., Washington, D. C.

COMPARISON OF NEUTRON FLUX VALUES OBTAINED BY SIMULTANEOUS IRRADIATION OF FISSION AND THRESHOLD MONITORS

C. Z. Serpan, Jr. and L. E. Steele *In its* Rept. of NRL Progr. Apr. 1967 p 1–4 refs (See N68-12918 04-34)

As part of a continuing study of the effects of nuclear radiation on reactor structural steels, several types of monitors

have been tested to assess their usefulness in determining the intensity of neutron flux. Recently both fission (Np^{237} and U^{238}) and iron threshold monitors were irradiated simultaneously; some of the monitors were irradiated for 1363 hours, others for only 20 hours. The results of these tests did not indicate that the fission monitors had any advantage over the threshold type, although they may prove to be useful in the future. Author

N68-13051 United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
DESIGN AND USE OF SIMPLE REACTIVITY METERS FOR FAST REACTORS
H. Atkinson, P. R. James, and D. Tait 21 Jun. 1967 27 p refs
(TRG-1526(D)) HMSO: 4s 6d

Reactivity changes in a reactor near critical can be measured both more accurately and more quickly by a reactivity meter than by period measurement techniques. Two simple, accurate reactivity meter systems have been tested. These designs and a description of the experimental measurements and tests are presented. The simpler system is recommended for use on all fast reactors where reactivity changes are to be measured, and the principle is applicable to other reactor systems where a reasonably smooth current or voltage signal proportional to the reactor power can be obtained. Author

N68-13082# Nuclear Utility Services, Inc., Washington, D. C.
RADIOLOGICAL SAFETY STUDIES OF SPACE NUCLEAR SYSTEMS Quarterly Report, 13 Sep.–13 Dec. 1966
J. R. Coleman and R. S. Denham Jan. 1967 39 p refs
Prepared for Sandia Corp.
(SC-CR-66-2144; QR-1) CFSTI: HC $3.00/MF $0.65

The purpose of Task I of this contract was primarily to define and consider those portions of the overall problem which will require the greatest modification of the Rover Flight Safety Analysis. Concern in this early stage was directed primarily at movement of materials through the environment to man. Portions of the food chain including vegetation and meat were considered and the new ICRP lung model was generalized as much as possible for application to this project. Efforts under Task II were limited to collection and review of imput information on SNAP-19, which uses ^{238}Pu as a power source, and SNAP-29, which uses ^{210}Po. Possible problem areas with the safety analysis of SNAP-19 were identified. Work presently in progress under Task IV includes development of generalized safety criteria for aerospace systems and calculation of radiation dose to tissue from spherical particles of isotopic fuel materials. Author (NSA)

N68-13359 European Atomic Energy Community, Ispra (Italy).
USER'S MANUAL FOR THE GAMMA TRANSPORT CODES BIGGI 3P AND BIGGI 4T
H. Penkuhn Brussels Sep. 1967 142 p refs
(EUR-3555.E)

The Biggi programs (in Fortran) calculate in plain or spherical multilayer geometry gamma angular fluxes, spectra and response functions, buildup factors and albedos. They need a 32-K-storage, and Biggi 4T furthermore needs four intermediate tapes. The computing time on the IBM 7090 is about 15 sec per spatial point, and an exponential transformation allows great spatial integration steps, up to 2.5 mfp. In Biggi 3P the sources are monoenergetic and located on an outer boundary plain, in Biggi 4T they are volumic and can be rather arbitrary in energy and spatial dependence. Furthermore Biggi 4T contains a library with the gamma data of 30 elements. Some sample cases are described, and part of their results is compared with those of other authors. Author

N68-13373# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Reactor Physics Branch.
LATTICE MEASUREMENTS WITH 19-ELEMENT RODS OF ThO_2–$U^{235}O_2$ IN HEAVY WATER MODERATOR. PART I: BUCKLING, FINE STRUCTURE, AND NEUTRON SPECTRUM PARAMETERS
A. Okazaki and S. A. Durrani Oct. 1967 54 p refs
(AECL-2778)

Lattice parameters were measured for heavy-water-moderated lattices of 19-element clusters of ThO_2 containing 1.5 wt % enriched UO_2 (93 atom % U^{235}). Bucklings were determined from critical substitution measurements in the ZED-2 reactor using MICRETE, a two-group heterogeneous reactor code. Neutron density distributions and Westcott spectrum parameters r and T were obtained from measured Mn^{56}, In^{116} and Lu^{177} activities in foil detectors. Measurements were made for D_2O, air, H_2O and HB-40 coolants and for 22, 24, 28 and 32 cm triangular lattice pitches. Author

N68-13377 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
EXPERIMENTAL BURN-UP PROFILES BY GAMMA SCANNING AND COBALT MONITORING
G. Pugnetti 1967 34 p refs
(RT/ING(67)14) CFSTI: $3.00

This paper describes gamma scanning and Co60 activity measurements used as nondestructive means to evaluate burnup and its distribution in two irradiated charges of nuclear fuel samples examined at the Casaccia Hot Laboratory. The aim of this work was threefold: (1) to provide reliable burnup data of the fuel samples; (2) to investigate the possibilities offered by gamma scanning for detecting the radiation damage; (3) to obtain a direct experimental burnup profile in the 6EV channel of the ISPRA 1 reactor operated at power for a long time. Author

N68-13501*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 1, SYNOPSIS OF METHODS AND RESULTS OF ANALYSIS Final Progress Report
M. A. Capo, R. K. Disney, T. M. Jordan, and H. C. Woodsum Jun. 1967 179 p refs
(Contract NAS8-20414)
(NASA-CR-91541; WANL-PR-(LL)-010, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 18F

The three basic methods of calculating neutron and photon transport for nuclear rocket systems: Monte Carlo, S_n transport, and point kernel are evaluated for flexibility, convenience, accuracy, running time, ability to obtain angular and energy distributions. Two nuclear rocket reactor geometrical models, an NRX-type and a flight-type reactor system, were analyzed using both the early and final design methods. Comparisons between NRX experimental gamma ray dose rates, fast neutron (E>2.9 Mev) fluxes, and thermal neutron fluxes (E>0.4 ev) and data calculated by both methods are presented. Also, the point kernel, S_n transport, and Monte Carlo methods are evaluated for the flight-type reactor system. This evaluation includes external environment and propellant heating in both an on-axis and an off-axis propellant tank. Author

N68-13502* Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 2, THE POINT PROGRAM AND CROSS SECTION LIBRARY Final Progress Report

R. G. Soltesy and R. K. Disney Jun. 1967 146 p
(Contract NAS8-20414)
(NASA-CR-91543; WANL-PR-(LL)-010, V. 2) CFSTI: $3.00 CSCL 18F

POINT (Preparation of Input for Transport), a FORTRAN IV program for the IBM 7094 computer, is described. This program contains the basic microscopic cross section library, and input data processing routines to prepare input for the one-dimensional TAPAT program system, the two-dimensional transport program ODD-K and the data processing code for ODD-K, NAGS. The calculation of macroscopic cross sections readily usable in the transport programs, TAPAT and ODD-K, is achieved by employing a built-in library of region independent neutron and gamma ray microscopic cross sections. These group-averaged cross sections are applicable for the analysis of graphite-moderated nuclear reactor rocket systems. The program also calculates response functions as punched card output for use in both the TAPAT and NAGS programs to calculate, for example, neutron and gamma ray energy deposition, fixed neutron sources, or prompt and secondary gamma ray sources. Author

N68-13503*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 3, TAPAT—THE FORTRAN 4 PROGRAM SYSTEM (THE ANALYSIS PROGRAM AND TRANSPORT) Final Progress Report
R. K. Disney Jun. 1967 113 p refs
(Contract NAS8-20414)
(NASA-CR-91542; WANL-PR-(LL)-010, V. 3) CFSTI: HC $3.00/MF $0.65 CSCL 18F

A description of the TAPAT program system is presented which consists of five FORTRAN IV subprograms: 1) the ADDICT diffusion theory program which solves the multigroup diffusion equations in one-dimensional slab, cylindrical, or spherical geometries, 2) the MIST transport theory program which solves the multigroup S_n transport equations in one dimensional slap geometry, 3) the TOPIC transport theory program which solves the multigroup S_n transport equations in one-dimensional cylindrical geometry, 4) the MISPHT transport theory program which solves the multigroup S_n transport in one-dimensional spherical geometry, and 5) the FLUX EDIT data processing program which calculates reaction rates, distributed fixed sources, separable spatial and energy source distributions, and other radiation quantities of interest. The TAPAT subprograms ADDICT, MIST, MISPHT, and TOPIC are modifications of previously coded diffusion and S_n transport programs. The input data and internal operations of each program are standardized in a single program system that provides a complete, neutron and photon, one-dimensional radiation analysis of a reactor system in a single computer run. Author

N68-13504*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 4, KAP-V, THE POINT KERNEL ATTENUATION PROGRAM Final Progress Report
R. K. Disney and M. A. Capo Jun. 1967 184 p refs
(Contract NAS8-20414)
(NASA-CR-91540; WANL-PR-(LL)-010, V. 4) CFSTI: HC $3.00/MF $0.65 CSCL 18F

A description of the neutron and gamma ray point kernel attenuation program KAP-V, a computer program written in FORTRAN IV language, is presented. The program employs the point kernel method to calculate radiation levels at detector points located within or outside a complex radiation source geometry describable by a combination of quadratic surfaces. This program can be used, for example, to calculate gamma ray and/or fast neutron flux, dose, or heating rate. The attenuation function, or kernel, for gamma rays employs exponential attenuation along with a build-up factor. Three optional fast neutron attenuation functions are included: (1) a modified Albert–Welton function for calculating fast neutron dose rate using removal cross sections; (2) a bivariant polynomial expression for computing neutron spectra using infinite media moments data; and (3) a monovariant polynomial expression for computing neutron spectra using infinite media moments data. The program also handles either cylindrical, spherical, disc, line, or point sources. A variety of options are available for describing neutron or gamma ray source distributions in complex geometries. Author

N68-13505*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 5: TIC-TOC-TOE, A FORTRAN PROGRAM FOR THE TEMPERATURE IN THE COOLANT TANK AND OTHER CALCULATIONS AND FOR THE THERMAL NEUTRON ORIGINATING ENERGY Final Progress Report
T. M. Jordan and H. C. Woodsum [1968] 56 p refs
(Contract NAS8-20414)
(NASA-CR-91533; WANL-PR-(LL)-010, V. 5) CFSTI: HC $3.00/MF $0.65 CSCL 18F

A description of the TIC-TOC-TOE program for the Temperature In the Coolant Tank and Other Calculations and for the Thermal neutron Originating Energy is given. The TIC-TOC-TOE program, written in FORTRAN IV language, performs rapid calculations of heating rate distributions in on-axis liquid hydrogen propellant tanks. Neutron and photon sources from the reactor are expressed as multigroup, angular equivalent point sources. The propellant tank geometry is described by a series of axisymmetric truncated cones and/or cylinders. Basic heating rate data are interpolated from curve-fits of M. O. Burrell's Monte Carlo data which are built into the program. Author

N68-13506*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 6: ODD-K, A TWO-DIMENSIONAL TRANSPORT CODE Final Progress Report
R. K. Disney [1967] 81 p
(Contract NAS8-20414)
(NASA-CR-91534; WANL-PR-(LL)-010, V. 6) CFSTI: HC $3.00/MF $0.65 CSCL 18F

This volume is a manual for the utilization of the ODD-K program which numerically solves the Boltzmann transport equation using a multigroup, discrete direction representation of the particle flux in a two-dimension (R-Z, R-θ, or X-Y) geometry description of a reactor. The ODD-K program provides, in conjunction with the NAGS and DAFT codes, a method for obtaining neutron and photon spatial and energy distributions throughout the reactor system, and spatial, energy, and angular distributions of leakage fluxes at the surface of the reactor system. The code is presently operational on an IBM 7094 computer under the independent FORTRAN II monitor system. Tape assignments are compatible with the Marshall Space Flight Center (MSFC) IBM 7094 computer system. In addition, the ODD-K program operates under a revised FLOCO assembly program, FLOCOW II, which operates as a FORTRAN II monitor system program with off-line input, off-line output and FORTRAN II or IV tape operations. Author

N68-13507*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 7: NAGS, A FORTRAN 4 DATA PROCESSING PROGRAM FOR CALCULATION OF NEUTRON AND GAMMA RAY SOURCES AND NEUTRON AND GAMMA RAY HEATING IN TWO DIMENSIONAL GEOMETRIES Final Progress Report

R. K. Disney, R. G. Soltesz, and S. L. Zeigler [1967] 103 p
(Contract NAS8-20414)
(NASA-CR-91535; WANL-PR-(LL)-010, V. 7) CFSTI: HC $3.00/MF $0.65 CSCL 18F

A description of the Neutron Flux And Gamma Ray Source Edit (NAGS) program is presented. The NAGS program is a series of FORTRAN IV routines which process multigroup neutron and photon energy fluxes for two dimensional (R, Z or R, θ) geometry models. The NAGS program provides: (1) neutron and photon energy sources and distributions for use in point kernel, Monte Carlo, and photon transport analyses, (2) neutron and gamma ray dose rates, and (3) energy deposition data for use in subsequent thermal analyses. Source distributions which are output from the NAGS program are employed as input to the KAP-V point kernel program, the ODD-K two dimensional transport program, and the FASTER Monte Carlo program. Author

N68-13508*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 8: DAFT, ODD-K ANGULAR FLUX TAPES PROGRAM Final Progress Report

R. K. Disney and S. L. Zeigler [1967] 47 p
(Contract NAS8-20414)
(NASA-CR-91536; WANL-PR-(LL)-010, V. 8) CFSTI: HC $3.00/MF $0.65 CSCL 18F

A description of the DAFT (ODD-K Angular Flux Tape) program (a FORTRAN IV program for the IBM 7094 computer) is presented. This program is the data processing routine which prepares angular, spatial, and energy distribution data for input to the FASTER Monte Carlo program from the surface angular leakage flux data of the two-dimensional transport program ODD-K. The processing of the surface flux data in a form readily usable in the Monte Carlo program is achieved by reducing the surface multigroup angular leakage flux data into a histogram representation of the spatial, angular, and energy flux at the surface of a two-dimensional (R,Z) cylindrical reactor mockup. The DAFT program reduces the ODD-K surface angular flux data such that a limited number of areas, each having a defined angular energy flux, at the periphery of a reactor can be input to the FASTER program. Subsequently, the FASTER program can be used to predict the external radiation environment and/or propellant tank heating with a minimum amount of computer time and a maximum of accuracy for a given cost. If this ODD-K, DAFT combination is not used, the FASTER program must be used with volume distributed sources. Author

N68-13509*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

SYNTHESIS OF CALCULATIONAL METHODS FOR THE DESIGN AND ANALYSIS OF RADIATION SHIELDS FOR NUCLEAR ROCKET SYSTEMS. VOLUME 9: FASTER: A FORTRAN ANALYTICAL SOLUTION OF THE TRANSPORT EQUATION BY RANDOM SAMPLING Final Progress Report

T. M. Jordan Jun. 1967 265 p refs
(Contract NAS8-20414)
(NASA-CR-91538; WANL-PR-(LL)-010, V. 9) CFSTI: HC $3.00/MF $0.65 CSCL 18F

A description of the FASTER program, a Fortran Analytic Solution of the Transport Equation by Random sampling is presented. FASTER is a Fortran IV Monte Carlo program which calculates energy dependent neutron or photon fluxes at points, surfaces and regions of complex geometries. This program contains all the data processing routines required for a wide variety of nuclear vehicle applications. The FASTER program is completely variable dimensioned, and hence, is capable of treating problems of varying complexity within the limitation of total computer storage. The FASTER program deals with the entire spectrum of particle energies simultaneously, thus eliminating costly repetition of geometric calculations which are usually required for treating individual mono-energetic particles. The scattered particle energy spectra include the effect of every possible scattering event at each scattering point. This eliminates the variance associated with the random selection of a single event. Neutron transport calculations utilize averaged multigroup cross sections which are available from several standard tabulations. Photon transport problems utilize point cross sections and the Klein–Nishina equation for Compton scattering. Author

N68-13648# Commissariat a l'Energie Atomique, Saclay (France).

PRODUCTION OF POLONIUM 210 FOR ISOTOPIC PROPULSION [PRODUCTION DE POLONIUM 210 POUR LA PROPULSION RADIO-THERMIQUE]

R. Henry 1967 12 p refs In FRENCH; ENGLISH Summary Presented at the ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication
(ELDO-SP-67-17) CFSTI: HC $3.00/MF $0.65

Discusses problems connected with possible production of polonium 210 in Europe by means of bismuth irradiation an EDF graphite-gas power reactor and subsequent Bi/Po separation in fluidized bed in order to fabricate isotopic propulsion sources. Estimated costs are compared with current US costs.

Author (ESRO)

N68-13653# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.

MEASUREMENT OF FLUX DISTRIBUTION IN THE WINDSCALE ADVANCED GAS-COOLED REACTOR AT ZERO POWER, AND COMPARISON WITH CALCULATION

D. K. Cartwright, J. A. McKnight, and W. Pickering 1967 8 p refs
(TRG-1360(R))

During the commissioning of the Advanced Gas-cooled Reactor detailed radial and axial flux plots were made using 75% manganese-nickel wires 0.020 in. in diameter. This report describes these measurements and compares the results with those calculated using Argosy. The wires were fitted into the tie tubes of the fuel element and after removal, the wires were chopped from the long lengths and the γ activity measured using NaI scintillation counters. For the calculation, lattice cell constants were obtained from the Argosy 4 computer program in the three annular zones. The three zones were identified by the three sizes of re-entrant coolant passages designed to hold the moderator temperature fairly constant across the core. The reaction rate measurements described provide the best evidence available for comparison of reactor codes, and although restricted to the cold unirradiated condition the core contains so many different types of perturbations that it imposes a very severe test. The standard error of a normalized flux plot was predicted as about 1.5%. From the comparison of the measurements in one horizontal plane of 95 points with calculation it is concluded that Argosy can be used to obtain lattice data which enable the prediction of channel flux variation within a standard deviation of 2% in a cold unirradiated non-uniform core. Author

N68-13721# Walter Reed Army Inst. of Research, Washington, D. C. Div. of Nuclear Medicine.

RESPONSE OF LITHIUM FLUORIDE TO REACTOR NEUTRONS

R. E. Simpson *In* NRL Luminescence Dosimetry Apr. 1967 p 444–456 refs (See N68-13681 04-14)

Results from a study of the glow curves of TLD-100 and TLD-700 after γ-ray exposure are characteristically similar. However, after reactor exposures in a known field of thermal neutrons and γ-rays, significant differences were found in the 200° and 275°C glow peaks for approximately the same integrated area under the curves. It is postulated that these differences are primarily due to differences in the specific ionization of ejected electrons resulting from γ-rays vs. the 4.8-Mev α particles and ^3H recoils resulting from the $^6Li(n,\alpha)^3H$ reaction of the thermal neutrons. The glow curve characteristics have been significantly demonstrated by shielding the phosphors against thermal neutrons with the use of ^6Li or cadmium covers. By this technique a true γ-ray dose is obtained, producing the characteristic γ-ray-induced glow curve both for the TLD-100 and TLD-700. The average response (integrated light output) of the TLD-700 per 10^{10} nvt of thermal neutrons has been determined to be equivalent to that resulting from 0.7 rad (tissue) of ^{60}Co γ-rays, whereas the corresponding response of the normal phosphor is greater than that from 200 rad of γ-rays. Author

N68-13744# Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

COMPATIBILITY OF MATERIALS FOR ADVANCED SPACE NUCLEAR POWER SYSTEMS

W. O. Harms and A. P. Litman Oct. 1967 41 p refs Presented at the Ann. Meeting of the ASME, Pittsburgh, 12–17 Nov. 1967

(Contract W-7405-ENG-26)

(ORNL-TM-1964; CONF-671101-3) CFSTI: HC $3.00/MF $0.65

Results from more than a decade of national effort on compatibility problems in space nuclear power systems, in particular those based on the Rankine cycle are summarized. A review is presented of both the explicit and implicit results which have been gleaned from the many studies of conventional and refractory alloys with potassium and lithium as primary heat transfer fluids and with potassium and cesium as working fluids. The characteristics of single- and multiloop Rankine cycle power systems are described with emphasis on the corrosion problems associated with the components of each system. Recent developments in corrosion theory and experimentation are evaluated insofar as they yield solutions to these problems. Future service requirements and the direction of materials compatibility research are discussed. Author (NSA)

N68-13767# Oak Ridge National Lab., Tenn.

HIGH FLUX ISOTOPE REACTOR Quarterly Report, Apr.–Jun. 1967

R. V. McCord and B. L. Corbett 27 Sep. 1967 18 p

(Contract W-7405-ENG-26)

(ORNL-TM-2017) CFSTI: HC $3.00/MF $0.65

An operations history for the HFIR for the period of April–June 1967 is given. Special fuel elements irradiations are discussed. Pressurizer pump failure is summarized. Systems data are included. NSA

N68-13822# Case Inst. of Tech., Cleveland, Ohio.

THE HIGH POWER KINETICS OF A TWO-DIMENSIONAL CIRCULATING FUEL NUCLEAR REACTOR

Michael J. Kolar (Ph.D. Thesis) [1967] 86 p refs

A two-dimensional model of a single channel circulating fuel reactor is used to investigate the effect of a radial temperature distribution on the neutron kinetics. A slug flow model with no delayed neutrons is used. The effects of a non-uniform radial heat source distribution and thermal conductivity are taken into account. The effect of the reactor wall temperature distribution on the kinetics is discussed. Author

N68-13825*# Lockheed-Georgia Co., Marietta.

EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES Quarterly Report, 21 Jul.–21 Oct. 1966

C. A. Schwanbeck Nov. 1966 72 p refs

(Contract NAS3-7985)

(NASA-CR-91519; LAC-ER-8811; QR-5) CFSTI: HC $3.00/MF $0.65 CSCL 18F

An in-pile test program designed to determine the effects of a combined nuclear–cryogenic environment on the mechanical properties of materials (metals) used in the construction of nuclear rocket systems; is reported. Studied were the effects of: (1) 10^{18} n/cm^2 (E>0.5 MeV) at 30°R on tensile properties of titanium base alloys; (2) irradiation temperature (30°R to 540°R) on tensile properties of Aluminum 1099-H14 following irradiations up to 3×10^{17}n/cm^2 (E>0.5 MeV); (3) annealing following irradiation at 30°R to 10^{17}n/cm^2 (E>0.5 MeV) on tensile properties of Aluminum 1099; and (4) irradiation at 30°R on axial, low-cycle fatigue properties of titanium base alloys. All out-of-pile tensile testing and in-pile testing of Aluminum 1099, Ti–55A, Ti–5Al–2.5 Sn (ELI), Ti–5Al–2.5 Sn (Std. 1), and Ti–6Al–4V (annealed) was completed. Increases in strength functions, accompanied by moderate reductions in ductility, were observed in the titanium alloys and there was no evidence of saturation at 10^{18}n/cm^2 (E>0.5 MeV). Modification of two test loops for low cycle fatigue, including calibration of the load monitoring instrumentation was completed and the modified loops were used to perform out-of-pile tests at room temperatures; and at 30°R during irradiation, following irradiation to 10^{17}n/cm^2, and unirradiated. Cryogenic strenthening of Titanium 55A had a greater effect on tensile properties than on fatigue life; irradiation at 30°R to 10^{17}n/cm^2 produced a greater effect at high load levels than loads below 85% of the nominal F_{tu}. The effect of cryogenic strengthening of both interstitial levels of Titanium 5 Al–2.5 Sn on fatigue life was as pronounced as for tensile properties. S.C.W.

N68-13864# Oak Ridge National Lab., Tenn.

RADIOCHEMICAL DETERMINATION OF THE FISSION-PRODUCT RELEASE FROM COATED FUEL PARTICLES IN REACTOR IRRADIATION

H. J. Reidel [1967] 8 p refs Transl. into ENGLISH from German Rept. EUR-3271.D

(ORNL-TR-1789; EUR-3271.D) CFSTI: HC $3.00/MF $0.65

An important question in the use of coated particles as nuclear fuel carrier in operation of a high-temperature gas-cooled reactor is how much of the gaseous and nongaseous fission products penetrates the coating. The pyrolytic carbon coating can prevent contamination of the reactor cooling circuit with high-activity fission products. As part of a research program on the behavior of various types of particles as a function of operating temperature, burnup, etc., a radiochemical study was made of fission-product distribution when the coated particles were surrounded by graphite. For analytical separation and determination of the fission elements distillation, precipitation, liquid extraction, and ion exchange were used. The methods are described briefly. Twelve fission nuclides were determined. A surprisingly high mobility was found for barium, strontium, and yttrium. The release of other fission products with high fission yield was considerably lower. Some of the conditions affecting the fission product yield are discussed. Author (NSA)

N68-13868# AEG-Kernenergieanlagen, Frankfurt am Main (West Germany).

STABILITY EXPERIMENTS FOR BOILING WATER REACTORS Quarterly Report, 1 Jan.–31 Mar. 1967

31 Mar. 1967 42 p refs Transl. into ENGLISH from GERMAN

(Contract EURATOM-085-66-1-TEED)

(QR-9; EURAEC-1834; EUR-3357) CFSTI: HC $3.00/MF $0.65

Initial measurements were made on the four-rod cluster geometry: stationary density measurements and pressure drop measurements at various heights and with various water inlet velocities as well as 5 "heat transferred per surface unit–local steam bubble fraction" frequency characteristic measurement series. These measurement series were selected to allow a direct correlation with the frequency characteristics obtained for the cylindrical geometry.

The evaluation of these measurements is proceeding. To ensure proper identification of "heating tube-coolant" heat transfer, measurements were made on the heat transfer tubes in order to identify the heat-transfer coefficients of the material of which they are made. A method for deriving characteristic dynamic constants for the boiling zone from correlations revealed by stationary measurements is developed. The comparison between theory and experiment, using the AMOK-L computer program for the cylinder frequency characteristic measurements, was virtually completed. Author (NSA)

N68-13869# Brookhaven National Lab., Upton, N. Y.
TOWARD THE THEORY OF ATTENUATION OF THE DENSITY OF NEUTRONS FROM A PULSED SOURCE IN LIMITED VOLUMES OF THE MODERATOR
M. V. Kazarnovskii, L. V. Maiorov, and M. S. Yudkevich Aug. 1967 20 p refs Transl. into ENGLISH from Russian
(BNL-TR-154) CFSTI: HC $3.00/MF $0.65

The time dependence of the neutron distribution from a pulsed source in limited volumes of moderator is developed enabling one to calculate this dependence for real moderators. The estimations of the effect of the nonexponential attenuation show that the main quantitative conclusions obtained by Corngold and Durgun retain their validity under real conditions within the framework of the simplified model and prove the applicability of the approximation of Ghatak's "truncated" equation for not too large intervals of time. NSA

N68-13870# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
SAXTON PLUTONIUM PROGRAM Semiannual Progress Report, Period Ending 30 Jun. 1967
30 Jun. 1967 36 p refs
(Contract AT(30-1)-3385)
(WCAP-3385-12; EURAEC-1877) CFSTI: HC $3.00/MF $0.65

The purpose of the Saxton Plutonium Project is to develop information concerning the utilization of Pu enriched fuel in pressurized water reactor systems through design, fabrication and operation of a partial core of PuO_2–UO_2 in the Saxton reactor. In-pile performance of this fuel will be evaluated and post-irradiation examination of fuel samples will be made. Performance will be analyzed and compared with analytical predictions. Author (NSA)

N68-13871# General Electric Co., Sunnyvale, Calif. Advanced Products Operation.
WEIGHTED DOPPLER ANALYSIS CODE: WEDOP
D. Berman and C. D. Wilkinson Aug. 1967 66 p
(Contract AT(04-3)-540)
(GEAP-5543) CFSTI: HC $3.00/MF $0.65

The computer code WEDOP was developed for the SEFOR research and development program. The objective of WEDOP is to calculate the total reactor Doppler reactivity effect in a fast reactor for: a change between two equilibrium reactor conditions or during the early portion of a fast power transient. Program input includes a detailed description of the power distribution over the reactor core, together with temperature dependent heat transfer parameters to allow the calculation of the detailed fuel temperature distribution. The local Doppler reactivity is weighted with an appropriate weighting function to obtain the total Doppler reactivity. The code does not treat transient heat transfer; hence, the calculation of the Doppler effect during a fast power transient applies only for that period during which heat transfer from the fuel rod can be neglected. The code has been used to predict the Doppler reactivity effects associated with certain experiments to be conducted at SEFOR, and to investigate analytical models for fitting experimental data. It is planned that WEDOP will be used in analyzing certain experimental data obtained from the SEFOR experimental program. Author (NSA)

N68-13898# Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.
URANIUM PLUTONIUM CARBIDE DEVELOPMENT Quarterly Progress Report, Period Ending 30 Jun. 1967
William E. Ray Jul. 1967 70 p refs
(Contract AT(30-1)-3791)
(WCAP-3791-8; QPR-3) CFSTI: HC $3.00/MF $0.65

A basic fuel element design suitable for application in a commercial, liquid metal-cooled, fast breeder reactor (LMFBR) is described. Vented and sealed element designs are presented. The fuel used in both types of elements is a stabilized (U,Pu)C solid solution. For heat transfer reasons, the (U,Pu)C is Na-bonded to the fuel element claddings. Author (NSA)

N68-13900# Oak Ridge National Lab., Tenn. Atomics International, Canoga Park, Calif.
METHODS FOR CALCULATING FAST-NEUTRON LEAKAGE FROM THE SNAP-TSF REACTOR AND PRELIMINARY RESULTS
R. S. Hubner Oct. 1967 283 p Prepared for Atomics Intern.
(Contract W-7405-ENG-26)
(NAA-SR-Memo-12184; ORNL-TM-1666) CFSTI: HC $3.00/MF $0.65

The 05R Monte Carlo code and associated analysis codes were modified for use in the analyses of the ORNL SNAP-TSF experiments on the leakage of fast neutrons from a SNAP reactor. The reactor geometry is given in great detail. Anisotropic elastic scattering, beryllium (n,2n) reactions, and inelastic scattering processes are treated thoroughly. Important information obtained from adjoint S_n calculations was used to construct biased distributions in 05R for the selection of source neutron parameters and of neutron track lengths between reactions. Input instructions and listings for programs and subroutines that were developed are given in the appendices; flow diagrams for certain routines are also given. Power distributions, angular leakage flux, and fluxes viewed by collimated detectors were calculated for some preliminary analyses; 05R source neutron tapes for subsequent 05R calculations on the penetration of neutrons through a SNAP-2 shield were prepared. Requirements for the final analyses are given. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N68-12909* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EVALUATION OF OPTICAL THIN-FILM FILTERS WITH A DIGITAL COMPUTER AND DISPLAY
R. R. Bilderback Nov. 1967 11 p ref
(NASA-TM-X-58013) CFSTI: $3.00 CSCL 20F

An optical thin-film evaluation program was developed for the PDP-5/8 computer. The matrix method is employed in computing the transmittance of the multilayer stack, and a cathode ray tube is used to display the transmittance-versus-wavelength data. Author

N68-12922 Naval Research Lab., Washington, D. C.
THE TOTAL ELECTROMAGNETIC ENERGIES POSSESSED BY CONVECTION CURRENTS
J. W. Butler *In its* Rept. of NRL Progr. Aug. 1967 p 1–17 refs (See N68-12921 04-34)

The conventional equation for the total electromagnetic field energy density of moving charged bodies or convection currents, $dU/dV=(E^2+H^2)/8\pi$ (in Gaussian units), is theoretically inconsistent with the theory of relativity, both with respect to its Lorentz transformation properties and the answers it gives in specific problems. A new equation, $dU/dV=(E^2-H^2)/8\pi(1-\beta^2)$, is derived and proposed for the total electromagnetic field energy density of uniformly moving charged bodies, where β is the speed of the body in units of the speed of light. This new equation is shown to have the proper Lorentz transformation properties, and it is shown to yield answers consistent with the theory of relativity in several examples in which the conventional equation fails.

Author

N68-12928# Harvard Univ., Cambridge, Mass. High Pressure Lab.

ANALYSIS OF ULTRASONIC ABSORPTION MEASUREMENTS IN LIQUIDS AT HIGH PRESSURES

Walter H. Johnson, Jr. and Gerald Holton Oct. 1967 56 p refs *Its* Commun. No. 8

(Contract Nonr-1866(57))

(TR-4; AD-661832)

A method, complete with error analysis, is given for determining the absorption coefficient for ultrasonic pulses (alpha) and the loss at the mirror and crystal (gamma) as a function of pressure. Results of the analysis are presented for distilled water as well as n-propanol. An expression for the pressure-dependent mirror-crystal loss is derived and checked against the experimental values obtained. In addition, a second method, which uses the expression for gamma, is discussed which enables one to obtain the absorption coefficient more directly from fewer measurements.

Author (TAB)

N68-12930# Western Reserve Univ., Cleveland, Ohio.

STUDIES OF GENERAL RELATIVISTIC EQUATIONS FOR ROTATING MATTER, AND OF COLLECTIVE EFFECTS IN GRAVITATING DISTRIBUTIONS

G. E. Tauber and J. W. Weinberg Nov. 1967 10 p refs

(Grants DA-ARO(D)-31-124-G429; DA-ARO(D)-31-124-G668)

(AROD-3743.4-P; AD-661645)

The project was directed toward the solution of two outstanding problems in gravitation, the gravitational fields of rotating bodies and the collective effects of gravitation in statistical systems, i.e., galaxies of stars.

Author (TAB)

N68-12978# Mitre Corp., Bedford, Mass.

PHASE-INDEPENDENT METHODS FOR THE INVERSE DIFFRACTION PROBLEM

Robert M. Lewis Nov. 1967 25 p refs

(Contract AF 19(628)-5165)

(MTR-418; ESD-TR-67-381; AD-661980)

An earlier method for the inverse diffraction problem, using only the backscattering cross section as a function of aspect angle, yields the profile curve for a strictly convex body of revolution. If the profile curve has straight line segments, the body is not strictly convex. Nevertheless, it is shown that the method, when applied to such a body, yields the correct profile except for a shortening of the straight segment by a factor which is at worst 0.7.

Author (TAB)

N68-13048# Air Force Cambridge Research Labs., Bedford, Mass.

APPLICATION OF GEOMETRICAL OPTICS TO THE DESIGN AND ANALYSIS OF MICROWAVE ANTENNAS

F. Sheppard Holt Sep. 1967 46 p refs *Its* Environ. Res. Papers, No. 340

(AFCRL-67-0501; AD-661561)

The basic concepts of geometrical optics together with the additional assumption that lead to the geometrical optics approximation are described here. The eikonal equation is derived and the relationship of exact electromagnetic theory in the limit as wavelength approaches limit of 0 to geometrical optics is made evident. The application of the geometrical optics approximation to phase analysis and synthesis is described and an example of synthesis is presented. The concept of power flow in ray tubes is used to obtain approximations to power distributions in the antenna aperture, in the focal region, and in the far field. Ray analysis is used to determine those feed locations in the focal region that will most nearly collimate the far-field rays that lie in certain desirable planes. The Theorem of Malus is used to formulate the equal path length law and applications are given. Focal surfaces (or caustics) relative to a rectilinear congruence are defined and then used to present a geometrical optics description of the focal region. The equations of the focal surfaces of a paraboloid receiving a plane wave 20 degrees off-axis are calculated and photographs of three-dimensional models of the focal surfaces are shown.

Author (TAB)

N68-13115*# Lockheed Missiles and Space Co., Palo Alto, Calif.

DESIGN AND CONSTRUCTION OF AN ENGINEERING MODEL SOLID CRYOGEN REFRIGERATOR FOR INFRARED DETECTOR COOLING AT 50°K

R. P. Caren and R. M. Coston Washington NASA Jan. 1968 65 p refs

(Contract NAS5-9549)

(NASA-CR-988) CFSTI: HC $3.00/MF $0.65 CSCL 13A

Structural and thermal design evaluations for a spaceborne sublimating solid cryogenic refrigerator resulted in the development of a prototype stacked unit that uses two cylindrical cryogen containers and a common vacuum space. The argon and carbon dioxide containers keep infrared detector operating temperature down to about 52°K. The refrigerator is able to remain unvented and in solid state during spacecraft boost phase, as well as for several days of a hold phase before the temperature rises markedly.

G.G.

N68-13118*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion.

STATUS REPORT

Jun. 1967 106 p refs

(Grant NsG-316)

(NASA-CR-91449; INDEC-SR-12) CFSTI: HC $3.00/MF $0.65 CSCL 20C

Summary data are presented on research projects in materials, plasma, and electrochemical engineering. Each brief describes the objectives and previous accomplishments for the project involved. Details are given on the test apparatus, techniques, and experimental results obtained from research in: thermal diffusivity of liquids, thermoelectric properties of graphite alloys, tunnel emission cold cathodes, thermal transpiration, scalar electrical conductivity at very low ionization levels, freezing potentials, current and potential distribution in fuel cell design, foaming electrolyte fuel cells, atomic scale electrode processes, and decay of activation overpotential for potential dependent capacitance. A bibliography of publications is included.

E.J.S.

N68-13163# Queens Coll., Flushing, N. Y. Dept. of Physics.

THE SET OF OBSERVERS ASSOCIATED WITH A RELATIVITY PRINCIPLE

A. L. Harvey Nov. 1967 3 p

(Grant Nonr(G)-00018-67)

(TR-2; AD-661492)

Associated with any relativity principle is a set of equivalent observers. It is the purpose of this note to show that independently of the physical postulates which delimit the set of coordinate transformations connecting the various observers this set necessarily constitutes a group.

Author (TAB)

N68-13164# Naval Ship Engineering Center, Philadelphia, Pa.
MEASUREMENT OF ACOUSTIC VELOCITY IN STEAM Final Report
James W. Woodburn (North Carolina State Coll.) and Yaroslav J. Fostyk 31 Oct. 1967 50 p refs
(AD-661791)

A research facility was designed and erected to determine the velocity of sound in superheated steam at pressures and temperatures to 5000 psi and 800F. A vibrating quartz crystal was used to set up a series of standing waves in a cylindrical acoustic chamber. Frequency and wave length were determined at steam conditions up to 3400 psi and 719F. Experimental results show close agreement with velocities computed from the 1967 international formulations for steam. Velocity of sound in high pressure steam can be determined more accurately by ultrasonic methods than from calculated values based on currently available tables of thermodynamic steam properties. Author (TAB)

N68-13180 Royal Aircraft Establishment, Farnborough (England).
THE EVALUATION OF OSCILLATING SYSTEMS USING PROPOSALS PUT FORWARD BY RAYLEIGH AND TAKING INTO ACCOUNT THE CHARACTERISTIC MASS OF THE SPRING [DIE BERECHNUNG VON SCHWINGSYSTEMEN MIT DEM ANSATZ VON RAYLEIGH UNTER BERUCKSICHTIGUNG DER EIGENMASSE DER FEDERORGANE]
R. Liebold Aug. 1967 12 p Transl. into ENGLISH from Z. Angew. Math. Mech. (Berlin), v. 46, no. 5, 1966 p 319–321
(RAE-LIB-TRANS-1249) CFSTI: $3.00

A mass connected to a rigid support by a spring and without damping, two masses connected by a spring and without damping, and two masses connected by a spring and with damping are considered in the evaluation of oscillating systems. A simple, approximation solution is given for determining the amplitudes of the two masses by considering the characteristic mass of the spring and the damping of the system, using proposals of Rayleigh. The results obtained can be easily interpreted and their deviations from exact values are very small. M.W.R.

N68-13205 Max-Planck-Institut fur Stromungsforschung, Gottingen (West Germany).
THE SPINNING VORTICES AS A SOURCE OF SOUND
E. A. Mueller and F. Obermeier [1967] 11 p refs

Flow and sound field of a simple aerodynamic sound source—the two-dimensional spinning vortices—are calculated. In this calculation the method of matched asymptotic expansions is employed. This method for the solution of singular perturbation problems has been developed during the last years. It allows for the computation of an asymptotic solution of the differential equations of the flow, which is valid both in the near field and the far field. One obtains a seventh power law in a characteristic velocity U for the sound power radiated by unit length of the spinning vortices in contrast to the eighth power law obtained by M. J. Lighthill for three-dimensional flows. It is possible to generalize the above method to vortex flows and their radiation fields; results will be given. Author

N68-13258# Bureau of Mines, Pittsburgh, Pa. Health and Safety Research and Testing Center.
OPTICAL PROPERTIES OF GLASS: TRANSMISSION LOSSES OF EYEPIECES USED IN MINE ENVIRONMENT
C. Gary Reiness and Carmon L. Marano Jan. 1968 14 p refs
(BM-RI-7062)

A safety glass eyepiece which had been repeatedly exposed to mine environment over a number of years was studied to determine some of its optical properties. In the regions from 385 to 400 mμ and from 625 to 760 mμ, the transmittance was less than the 89% required by the American Standard Safety Code for Head, Eye, and Respiratory Protection. From 200 to 320 mμ the relative transmittance of two parts of the eyepiece was found to vary widely, having a maximum of 38% difference at 315 mμ. Irradiation of the glass by ultraviolet light caused enhanced absorption in the range from 200 to 1,200 mμ. There was a time-dependent increase of 10^{16} color centers per cubic centimeter throughout this range after 36.5 hours of irradiation. The rate-of-growth curve for the optical density, at 243.5 mμ and 23°C, was resolved into linear and saturable components, indicating zero order and first order kinetics. Author

N68-13273# Maine Univ., Orono. Dept. of Physics.
AN INVESTIGATION OF THE ORDERING OF MOLECULES IN THE ANISOTROPIC LIQUID PHASE OF LIQUID CRYSTALS Final Technical Report
Edward F. Carr [1967] 5 p refs
(Grant AF-AFOSR-605-64)
(AFOSR-67-2622; AD-661582)

A brief summary is given of work undertaken to obtain a basic understanding of the effect due to external electric fields on the molecular alignment in the anisotropic liquid phase of liquid crystals. A list of papers resulting from the work is included. TAB

N68-13320# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR. NEWS. MECHANICS
18 Apr. 1967 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (USSR), no. 5, 1965 p 131–134, 154–157
(FTD-HT-66-464; AD-661767)

CONTENTS:

1. THE STATIC STRENGTH OF METALS IN CONDITIONS OF A COMPLEX STRESSED STATE AND LOW TEMPERATURES P. F. Koshelev p 1–8 (See N68-13321 04-32)

2. BOUNDARY LAYER REACTION WITH A HYPERSONIC STREAM IN A CONICAL NOZZLE V. P. Agafonov p 9–15 refs (See N68-13322 04-01)

N68-13337 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MULTIPLE LIGHT SCATTERING IN A SPECTRAL LINE [O MNOGOKRATNOM RASSEYANII SVETA V SPEKTRAL'NOY LINII]
D. I. Nagirner *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Vol. 19, No. 1 20 Apr. 1967 p 175–183 refs (See N68-13323 04-19)

The multiple scattering of light in a spectral line is of interest to astronomers. It is usually assumed that such scattering takes place with a complete redistribution by frequency. This signifies that the probability of radiation in line of a quantum of a definite frequency does not depend on the frequency of the quantum when it was absorbed. In such case the transfer process can be described by a linear, integral equation whose kernel depends on the absolute value of the difference of the arguments. In the present article, these general formulas are applied to the solution of the problem of the scattering of light in a spectral line taking the redistribution by frequency into account. It is assumed that in a continuous spectrum there is no absorption. Both one- and three-dimensional media are considered. In both types of media the two cases when the absorption coefficient has a Lorentz and a Doppler profile are studied and asymptotic expressions for the resolvents are obtained. Author

N68-13393# Stanford Univ., Calif. Dept. of Materials Science.
CRYSTALLOGENICS Final Report
William A. Tiller 25 Oct. 1967 10 p refs
(Grant AF-AFOSR-731-65)
(SU-DMS-68-R-17; AFOSR-67-2600; AD-661334)

A summary is given of the results of a study aimed at an understanding of the freezing process. Specific areas of investigation included: thermodynamics of phase equilibria and surfaces; nucleation; solute redistribution; fluid motion; interface attachment; heat transport; interface morphology. A list of the 40 publications resulting from the work is included. TAB

N68-13394* Wyle Labs., Inc., Huntsville, Ala. Testing Div.
SHADOWGRAPH VISUALIZATION OF NOISE FROM COLD SUPERSONIC JETS
M. V. Lowson 31 Jan. 1967 70 p refs
(Contract NAS8-11312)
(NASA-CR-91337; WR-67-3) CFSTI: $3.00 CSCL 20A

Shadowgraphs of the sound field from over and under expanded cold supersonic jets, both deflected and undeflected, are presented and analyzed. Appendices present the results from a simple theoretical model, and recommendations for additional tests. It appears that the radiation field from the supersonic part of the jet is of relatively high frequency and that the sound from the subsonic part of the jet is the principal contributor to the overall sound power. In the supersonic region the apparent order of significance of the noise sources is (I) radiation from the nozzle, (II) radiation from shock-turbulence interaction within the jet flow, (III) Mach wave radiation. The significance of the first source is thought to be due to the small scale of the present experiments, and demonstrates the necessity for care in extrapolation of small scale acoustic results. The second source will not be present in perfectly expanded jet flows. The principal noise source from the deflected jet appears to arise from the jet-deflector intersection and associated shock pattern. Author

N68-13461# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
QUARTERLY PROGRESS REPORT NO. 87
H. J. Zimmermann, G. G. Harvey, and S. J. Mason 15 Oct. 1967 263 p refs
(Contracts DA-28-043-AMC-02536(E); N00014-67-A-0204-0019; N00014-67-A-0204-0009; AF 33(615)-3885; AF 19(628)-6066 et al
(QPR-87; AD-661448)

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15. COMPUTATION RESEARCH E. C. River, E. S. Brown, J. Harwitt, E. C. Isaacs, E. Kleban et al p 231–235 (See N68-13476 04-08)

N68-13468# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
PHYSICAL ACOUSTICS
K. U. Ingard and L. W. Dean, III *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 47–51 refs (See N68-13461 04-23)

Multimode argon-ion laser heterodyne spectroscopy was used to determine the spectrum of light scattered by thermal fluctuations of a liquid surface. In this technique, the laser and scattered light beams were combined at the surface of a photodetector; if temporal interference occurs, the surface fluctuation spectra can be directly observed by radiofrequency spectrum analysis of the phototube current. Using a single-mode helium-neon laser with the beam focused by a 10-cm lens to a small spot on a methanol surface, a correlation in arrival of photoelectrons was observed at a collecting angle of ≈ 10 mrad. Observations of light diffraction by ultrasonic waves in LaF_3 and CdS crystals showed that hexagonal crystal groups possessed acoustic isotropy over the entire basal plane, since the elastic constant tensor components are invariant for rotations about the c-axis($\vec{c}$). For any wave vector $\vec{k}$ lying in the basal plane the three corresponding acoustic waves were pure modes; however, initial measurements indicated that neither LaF_3 nor CdS compared favorably with other low acoustic-loss crystals available. G.G.

N68-13519* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A FORTRAN IV PROGRAM FOR CALCULATING AND PLOTTING SURFACE AREA AND PORE SIZE DISTRIBUTION DATA OBTAINED BY THE BET-GAS ADSORPTION METHOD
Gerald Halpert Oct. 1967 23 p refs
(NASA-TM-X-63061; X-735-67-505) CFSTI: $3.00 CSCL 07D

Surface area and pore size distribution of materials can be determined using the gas adsorption method of Brunauer, Emmett and Teller (BET), and Pierce. Both techniques involve lengthy, tedious calculations. A Fortran IV program was developed to facilitate the calculating process. The above-mentioned techniques and the computer program are the subject of this paper. Author

N68-13678# Aeronautical Research Council (Gt. Brit.).
SOME NUMERICAL METHODS FOR OBTAINING HARMONIC AND SUBHARMONIC SOLUTIONS OF DUFFING'S EQUATION
M. Newby London HMSO 1967 23 p refs Supersedes RAE-TR-65222; ARC-27779; see X66-13369
(ARC-R&M-3516; RAE-TR-65222; ARC-27779) HMSO: 10s 6d

Harmonic and subharmonic solutions are determined numerically for the forced oscillations of a system governed by Duffing's equation, and the stability of these oscillations is discussed.
Author

N68-13771 European Atomic Energy Community, Ispra (Italy). Lab. Gas Ionizzati.
MEGAGAUSS FIELDS AS A TRANSMITTING MEDIUM FOR VERY HIGH PRESSURES
H. Knoepfel 15 Sep. 1967 14 p refs Presented at the High Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

Transient magnetic fields at the megagauss level transmit to electrical conductors pressures of the order of megabars. The advantage of such compression lies mainly in the accessibility of the compressed specimen and in the possibility to sustain the high pressures during many μsec. The advantages and potential limitations of this method are discussed on the basis of extensive experimental experience in the domain of explosively generated megagauss fields.
Author

N68-13795 Los Alamos Scientific Lab., N. Mex.
HUGONIOTS OF GRAPHITES OF VARIOUS INITIAL DENSITIES AND THE EQUATION OF STATE OF CARBON
R. G. McQueen and S. P. Marsh [1967] 9 p refs Presented at the High-Dyn. Pressure Symp., Paris 11–15 Sep. 1967 Sponsored by AEC

The Hugoniot equation of state of several graphites has been measured using the shock-wave impedance-match technique. For these experiments 2024 Al was used as a standard. Its equation of state was based on the linear shock velocity–particle velocity Hugoniot $U_s = 5.46 + 1.318\ U_p$ where velocities are in km/sec. The product of the zero-pressure density, $\rho_0 = 2.785$ g/cm^3, and the Grüneisen ratio, $\gamma_0 = 1.89$, determined from shock wave data on porous 2024 Al, was assumed constant ($\rho\gamma = 5.26$ g/cm^3) and was used to calculate the required thermodynamic states off the Hugoniot. The various graphite specimens were made from standard commercial grades, or were hot or cold pressed in this laboratory. The diamond specimens were made by pressing diamond powder with graphite binder into disks approximately 3/8" to 1/2" in diameter. We estimate the composition of these samples to be ≈95 wt. % diamond and 5 wt. % graphite pressed to about 94% of the theoretical density of the mixture. The experimental data and the results of the impedance match solution are presented. The Hugoniots of pyrolytic graphite measured by Doran and Coleburn are also in good agreement with this work. We have transformed Ceylon graphite isotherms to Hugoniots and have plotted them with our data. The two sets of static data lie on the same curve with Bridgmen's, going to a $U_p = 0.7$ km/sec.
Author

N68-13831*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
7090 COMPUTER PROGRAM FOR DETERMINATION OF PRECISION LATTICE CONSTANTS
M. H. Leipold and W. R. Pauly 15 Feb. 1963 11 p refs
(Contract NAS7-100)
(NASA-CR-91502; JPL-TM-33-109) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A 7090 computer program was developed for the calculation of lattice parameters and their respective accuracies for cubic, tetragonal, and hexagonal materials. The analysis is based on a root-mean-square fit of the data and extrapolation of the lattice constants versus $(\cos^2\theta/\sin\theta) + (\cos^2\theta/\theta)$. Instructions for use of the program and interpretation of results are included. Comparison of the accuracy of some standard X-ray diffraction techniques is made by means of the program. Results indicate similar accuracy and sensitivity are available with a 114-mm Debye–Scherrer camera, a back-reflection camera, or a goniometer.
Author

N68-13877# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON COMPUTED CONCENTRATION PROFILES IN NORMALLY FROZEN RODS
C. H. Li Dec. 1967 8 p refs Submitted for publication
(RM-394J)

The effect is studied of experimental errors in the segregation coefficient on the computed solute concentration or concentration profile. Conditions requiring special precautions are given, and a scheme to minimize the effects of these experimental errors is proposed. As an example, a problem is considered that arises in the semiconductor field, where critical devices or circuitries may be made from matched wafers cut from identical locations on different crystals. It is shown that slight experimental errors in the segregation coefficient do not materially affect the concentration in the matched wafers by this scheme.
Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-12813# Yeshiva Univ., New York. Belfer Graduate School of Science.
COMPUTER "EXPERIMENTS" ON CLASSICAL FLUIDS. 2. EQUILIBRIUM CORRELATION FUNCTIONS
Loup Verlet Apr. 1967 53 p refs
(Grant AF-AFOSR-508-66)
(TH-196; AD-660612) CFSTI: HC $3.00/MF $0.65

Equilibrium correlation functions for a dense classical fluid are obtained by integrating the equation of motion of a system of 864 particles interacting through a Lennard-Jones potential. The behaviour of the correlation function at large distance, and that of its Fourier transform at large wave number are discussed in detail and shown to be related to the existence of a strong repulsion in the potential. A simple hard sphere model is shown to reproduce very well the Fourier transform of those correlations functions at high density, the only parameter of the model being the diameter a of the hard spheres.
Author (TAB)

N68-12852 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
AN ANALYSIS OF NUCLEAR INTERACTIONS OF ENERGIES $\geq 10^{12}$ eV BY MEANS OF PHOTOEMULSIONS [ANALIZA ODDZIALYWAN JADROWYCH O ENERGIACH $\geq 10^{12}$ eV NA PODSTAWIE DANYCH EMULSYJNYCH]
M. Mensovich and E. Gerulya 1967 29 p refs In RUSSIAN; ENGLISH and POLISH summaries
(Rept.-813/6/PH)

Results of an analysis of interactions between nucleons of energies higher than 10^{12} eV and emulsion nuclei in two large emulsion stacks are presented. The main results of the emulsion work are presented from the point of view of the fireball model taking into account the possibility of the excitation of the nucleons.
Author

N68-12893# Chicago Univ., Ill. Lab. of Molecular Structure and Spectra.
QUANTUM MECHANICAL CALCULATION OF LIGHT METAL DIATOMIC HYDRIDES, OXIDES, AND HALIDES Final Report, 12 Jun. 1959–11 Jun. 1966

C. C. J. Roothan and B. J. Ransil 11 Jun. 1966 21 p refs
(Contract DA-11-022-ORD-3119; ARPA Order 368)
(AROD-3835.38-P; AD-661065)

Results for diatomic molecules in minimal LCAO-MO-SCF approximation is reviewed, and the gradual extension of this effort first to double-zeta LCAO-MO-SCF results and presently to true Hartree-Fock accuracy by the matrix method is discussed. The range of diatomic molecule-systems treated, the related molecular properties calculated, and physical or chemical interpretation efforts are outlined. A resume is also given of certain polyatomic calculations carried out. This latter effort includes limited (or minimal) basis set calculations for certain linear triatomic molecules, methane, andone-center expansion calculations for AHn hydrides, all within the self-consistent-field procedure. Calculations on the hydrogen molecule using a lengthy James-Coolidge expansion, were carried to within a few kaysers of experiment for the ground and certain few excited states. Author (TAB)

N68-12904 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
MEASUREMENTS OF THE ANGULAR DISTRIBUTIONS OF PARTICLES GENERATED IN NUCLEAR INTERACTIONS REGISTERED IN NUCLEAR EMULSIONS [POMIAR ROZKLADU KATOWEGO CZASTEK GENEROWANYCH W ODDZIALYWANIACH JADROWYCH ZAREJESTROWANYCH W KLISZACH
T. Coghen, Z. Czachowska, A. Jurak, S. Krzywdzinski, K. Rybicki et al 1967 49 p In POLISH; ENGLISH summary
(Rept.-794/6/PH)

A procedure of measurement of the angular distribution is given. Special attention was paid to the measurements of small angles (<1 mr) which are present in high energy (>1 TeV) interactions. Author

N68-12933 Australian National Univ., Canberra. Research School of Physical Sciences.
ENERGY LEVELS OF O^{16} IN THE VICINITY OF 13 MEV-3
J. M. Morris, G. W. Kerr, and T. R. Ophel [1967] 33 p refs

Angular distributions and excitation functions of the elastic scattering reaction $C^{12}(\alpha,\alpha_0)$ have been analysed in terms of complex phase shifts for the range of incident alpha particle energies 6.6 MeV $\leq E_\alpha \leq$ 8.4 MeV. The results confirm the presence of four levels in the compound nucleus system O^{16} at excitation energies of 13.01, 13.08, 13.12 and 13.25 MeV respectively. Level parameters for the states at 13.01 and 13.12 MeV have been deduced with more accuracy than from previous measurements. Author

N68-12960*# Cornell Univ., Ithaca, N. Y. School of Electrical Engineering.
RESEARCH INTO ADVANCED CONCEPTS OF MICROWAVE POWER AMPLIFICATION AND GENERATION UTILIZING LINEAR BEAM DEVICES Semiannual Status Report
P. R. McIsaac Dec. 1967 40 p refs
(Grant NGR-33-010-047)
(NASA-CR-91281) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Continuing research is summarized on a theoretical study of some aspects of the interaction between a drifting stream of electrons with transverse cyclotron motions and an electromagnetic field. Particular emphasis is given to the possible generation and amplification of millimeter waves. The report includes brief discussions of the waves of a spiraling filamentary electron beam and the characteristics of magnetically focused, solid electron beams, with relativistic effects included in both cases. Author

N68-12996 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
NOTE ON THE AZIMUTHAL ASYMMETRY OF THE SECONDARY PARTICLE EMISSION IN A HIGH ENERGY NUCLEAR REACTION [ASYMETRIA AYMTALNA EMISJI CZASTEK WTORNYCH W REAKCJACH JADROWYCH WYSOKIEJ ENERGII]
E. Balcer, T. Siemiarczuk, and P. Zielinski 1967 13 p refs Submitted for publication
(INR-819/VI)

The azimuthal asymmetry in a class of secondaries in the 780 interactions of 9 GeV negative pions with xenon nuclei is observed. The observed asymmetry is correlated with the previously established occurrence of the p–p final state interaction in the secondary particle emission. Author

N68-13030# Illinois Univ., Urbana. Physics Dept.
SEQUENTIAL-DECAY ASPECTS OF THE REACTION $^{16}O(\alpha, 2\alpha)^{12}C_{GS}$
A. W. Parker, J. S. Allen, R. L. Yerke, and V. G. Stotland [1967] 9 p refs
(Contract N00014-67-A-0305-0005)
(AD-661347)

A plane-wave Born approximation is used to show that the reaction 16O(alpha, 2 alpha)12C-GS at an incident energy of 25 MeV proceeds predominantly as inelastic alpha-scattering followed by alpha-decay of the excited 16O recoil nucleus. An analysis of the data using this theory confirms the spin and parity assignments of 4(+) for the 11.09 and 13.88 MeV levels. Author (TAB)

N68-13040# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACCELERATOR-BUNCHER OF ELECTRONS [USKORITEL-GRUPPIROVATEL' ELEKTRONOV]
Ye. L. Kosarev 26 Jul. 1967 19 p refs Transl. into ENGLISH from Electron. Bol'shikh Moshchnostey (Moscow), no. 4, 1965 p 190–205
(FTD-MT-66-159; AD-661900)

Results are presented of numerical calculations of electron grouping in field of oscillations E010 and E011 of a cylindrical resonator. Conditions of bunching with dimensions of electron bunch to 1/100 wavelength of accelerating field with capture in these conditions of up to one third of all emitted electrons were obtained. Author (TAB)

N68-13089# Naval Radiological Defense Lab., San Francisco, Calif.
CHARGED PARTICLE TRACKS IN POLYMERS NO. 5: A COMPUTER CODE FOR THE COMPUTATION OF HEAVY-ION RANGE-ENERGY RELATIONSHIPS IN ANY STOPPING MATERIAL
Richard P. Henke and Eugene V. Benton 29 Nov. 1967 27 p refs
(USNRDL-TR-67-122; AD-661796)

A computer program to generate range and stopping power tables is described. This program can be used to compute the range and rates of energy loss of any ion in any stopping material of known atomic composition over the energy interval 0.04 - 1200 MeV/nucleon. The program extends the generalized expressions of Barkas and Berger to lower energies by using the range data of Whaling and the range extensions for emulsion of Heckman, et al., and Henke and Benton. It approximates existing data well. Included in this report are a flow chart, a listing of the Fortran IV coding, and sample output for comparison purposes. Author (TAB)

N68-13121# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ELEMENTARY PROCESSES OF HIGH-ENERGY CHEMISTRY

M. V. Gur'yev and L. V. Sumin 4 May 1967 449 p Transl. into ENGLISH of the book "Elementarnyye Protsessy Khimii Vysokikh Energiy" Moscow, Izd. Nauka, 1965 p 1-318 Presented at the Meeting, Moscow, 18-22 Mar. 1963
(FTD-MT-66-04; AD-661887)

The document is comprised of translations of condensed versions of over 60 papers presented at a symposium sponsored by the AN SSR Institut Khimicheskoy Fiziki in March 1963. Papers concerning the following areas of research are included: Elementary processes in gases with the participitation of electrons and ions; gas phase reactions of hot atoms; general questions in the theory of elementary gas reactions; Reactions in the ionosphere; Complex processes at high temperatures and in plasmas; Electron energy transfer; Electrons and ions in solid organic media; Formation and recombination of free radicals in solids; Mechanisms of photochemical and radiation-chemical reactions; Chemical reactions as possible sources of induced radiation. TAB

N68-13129# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INTRODUCTION TO THE THEORY OF ATOMIC SPECTRA

I. I. Sobel'man 6 Apr. 1967 779 p refs Transl. into ENGLISH of the book "Vvedeniye v Teoriyu Atomnykh Spektrov" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1963 p 1-640
(FTD-MT-64-542; AD-661902)

The book is devoted to a systematic presentation of the physical bases and the theory of atomic spectroscopy. The presentation is based on the modern theory of angular moments. There is also a systematic examination of the problems of excitation and radiation of atoms. These problems are of interest from the point of view of the use of spectroscopic methods in investigating various physical phenomena. Author (TAB)

N68-13169 European Organization for Nuclear Research, Geneva (Switzerland).

MESON RESONANCES

L. Montanet 6 Sep. 1967 85 p refs
(CERN-67-23)

In these lectures, we shall review the present experimental situation of meson states. We shall limit ourselves essentially to the strong interaction aspects of the problem, therefore excluding topics such as leptonic decay modes of K mesons, and possible asymmetries in the $\pi^+\pi^-\pi^0$ decay mode of the η meson. Even in the field of strong interactions, we shall be more concerned with the intrinsic properties of the meson states than with their production mechanism. We shall first review briefly the basic techniques used in the determination of the properties of the meson states: conservation laws and selection rules, spin-parity analysis, Dalitz plot. We shall also mention some of the difficulties often encountered in the analysis of resonances, rescattering effects and Peierls' mechanism, interference effects, and Deck mechanism. Of course, these topics will not be studied in great detail: our survey is simply intended to allow everybody to follow the phenomenological description which will be presented on the meson states. For systematic discussions, we shall refer to specialized articles and review papers. Author

N68-13310 Australian National Univ., Canberra. Research School of Physical Sciences.

ENERGY LEVELS OF O^{17} FROM $C^{13}(\alpha,\alpha_0)C^{13}$ AND $C^{13}(\alpha,n)O^{16}$

G. W. Kerr, J. M. Morris, and J. R. Risser [1967] 31 p refs
(ANU-P/388)

The $C^{13}(\alpha,\alpha_0)C^{13}$ cross sections at center-of-mass angles 54.7°, 90°, 149.4° and 169.6° and $C^{13}(\alpha,n)O^{16}$ cross sections at 0° have been measured over the range of α-particle energies 3.5 MeV to 6.5 MeV. Angular distributions for the $C^{13}(\alpha,n)O^{16}$ reaction have been measured at a number of energies within this range. From a dispersion theory analysis a consistent set of J^π and partial width values have been obtained for eleven states of the compound nucleus O^{17} with excitation energies between 9 and 10 MeV. Author

N68-13378 European Organization for Nuclear Research, Geneva (Switzerland). Theoretical Study Div.

ARE PION-PION SCATTERING EXPERIMENTS FEASIBLE?

Paul L. Csonka 1967 46 p refs Submitted for publication
(CERN-67-30)

The paper discusses the significance and the feasibility of observing the scattering of two real pions on each other. The importance of new machines, storage rings and unconventional techniques, is emphasized. Order of magnitude estimates are given for the following: for low laboratory energy pions, scattering in minirings. For high laboratory energy pions, self-clashing and head on colliding of pion beams. The estimates include machines now working or planned, all without and also in combination with storage rings. Author

N68-13395# Tufts Univ., Medford, Mass.

HIGH ENERGY PHYSICS AT TUFTS UNIVERSITY Progress Report, Sep. 1967

J. K. Knipp Sep. 1967 14 p refs
(Contract AT(30-1)-1984)
(NYO-1984-11) CFSTI: HC $3.00/MF $0.65

Brief summaries of experimental work on high energy particle interactions completed or in progress are given. Also proposed experiments are described. Instrumentation development work for bubble chambers and spark chambers is discussed. Also laser beam studies are described. NSA

N68-13411 European Organization for Nuclear Research, Geneva (Switzerland). Intersecting Storage Rings Div.

PERIODS OF PHASE OSCILLATIONS AS A FUNCTION OF AMPLITUDE

H. Koziol 2 Oct. 1967 25 p refs
(CERN-67-29)

Particles contained in an rf-bucket will perform non-linear oscillations around the stable phase angle. At infinitely small amplitudes, i.e. for particles very near to the phase stable point, these oscillations can be regarded to be linear and the period is a simple function of $\Gamma = -\sin\phi_s$. For finite amplitudes the period can be calculated by numerical integration. This report gives the dependence of the phase oscillation period $\Theta(\Gamma,\kappa)$ on Γ and amplitude κ in graphical and tabulated form. Author

N68-13418# Cornell Univ., Ithaca, N. Y. Materials Science Center.

EFFECTS OF IMPURITIES ON LATTICE VIBRATIONS. A MODEL CALCULATION INCLUDING MASS AND FORCE

Katja Lakatos (Ph.D. Thesis) Jun. 1967 285 p refs
(Contracts AT(30-1)-2391; AT(30-1)-3699)
(NYO-2391-45; NYO-3699-8) CFSTI: HC $3.00/MF $0.65

The effects of a low concentration of impurities on the vibrational properties of cubic monatomic harmonic lattices were studied. The problem is formulated in terms of a slow-neutron scattering experiment. The model used allows for both the mass of the impurity and the force constants binding it to its nearest, and in some cases next nearest, neighbors in the lattice to be different from those of a host atom. Numerical computations are performed on Al containing heavy impurities, with force constants treated as parameters that are varied over a wide range. The results are compared to those obtained from Taylor's model, which only allows for mass change. It is found that the resonance characteristics of the impurity are much more sensitive to force-constant changes than to mass change. When mass and forces change in the same

direction (e.g., heavy impurity, weak force constants), there is only one impurity resonance mode. When the changes are in opposite directions, two resonances, or one resonance and one localized mode, appear. It is also found that when force-constant changes occur, the neighbors of the impurity share much more in the resonance motion than when only a mass change occurs. Author (NSA)

N68-13443# Army Electronics Labs., Fort Monmouth, N. J.
A METHOD FOR TREATING THE SCATTERING OF RADIATION IN BODIES OF ARBITRARY CONVEX GEOMETRY
Harry L. Berkowitz Sep. 1967 18 p refs
(ECOM-2873; AD-661629)

A method is presented for formulating problems involving the passage of particles through material bodies of arbitrary convex geometry in which the interaction between a particle and the body depends on the length of the straight line path traveled. The radiation environment is described by a projected cross-section and an angular chord distribution, permitting the effects of geometry to be treated independantly of the physical process involved. The method is first formulated for bodies scattering incident radiation, and then extended to include bodies containing uniformly distributed anisotropic radiation emitters. Two sample problems are solved: the response of a scintillator to an X-ray flux, and the spectrum of recoil protons emerging from a hydrogenous body irradiated by a monergic neutron beam. Angular chord distributions are calculated for a sphere, an infinite slab, an infinite cylinder, and the face of a semi-infinite cylinder. Author (TAB)

N68-13447# Adelaide Univ. (Australia). Dept. of Physics.
AN EXPERIMENTAL DETERMINATION OF THE OSCILLATOR STRENGTHS FOR SOME TRANSITIONS IN THE LYMAN BANDS OF MOLECULAR HYDROGEN
G. N. Haddad, K. H. Lokan, A. J. D. Farmer, and J. H. Carver 1967 21 p refs
(Grant AF-AFOSR-1131-66)
(AD-661986)

The ultraviolet absorption cross-section for molecular hydrogen at room temperature was measured absolutely at a resolution of 0.3A, between 1060 and 1130A. This range of wavelengths covers the (0-0) through (3-0) vibrational bands of the B(1)Sigma(+)u - X(1)Sigma(+)g Lyman system. The nature of the curve of growth of an individual line was investigated in detail, and shown to agree closely with the expected behavior of a Doppler broadened Lorentz line for hydrogen at room temperature. A curve of growth analysis has been used to determine absolute line strengths for all observed transitions within each band. For each band the distribution of line strengths is in accordance with the expected weighted Boltzmann distribution of initial states at room temperature, with most of the observed absorption concentrated in the Ro, R1 and P1 transitions. Oscillator strengths for these bands were derived from the integrated band intensities, and confirm, within the limits of the experimental errors, the theoretical Franck-Condon factors. Author (TAB)

N68-13462# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MOLECULAR COLLISIONS
J. L. Kinsey, J. S. Kittelberger, and E. K. Parks *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 1-3 refs (See N68-13461 04-23)

Preliminary results of molecular potassium and cesium beam scattering with SO_2, CO_2, and NO demonstrated collision complex long lifetimes as compared with rotation time of the complexes. Intensity measurements of scattered alkali atoms as a function of angle showed a SO_2 peak that lasted long enough to rotate several turns before breaking up into the reactant species, an alkali atom and an SO_2 molecule; the angular distribution of the complex became eventually isotropic in the center of mass coordinate system and yielded a peak in the laboratory distribution corresponding to the scattering angle of 180°. The position of the laboratory peak was sensitive to the inelasticity of the collision energy transferred into rotation and vibration. It was concluded that the inelasticity varied from ≈20% to 50% of the initial relative kinetic energy, that its distributions are very broad, and that vibrational excitation seemed to occur with very small probability. In the case of NO, no peak was observed, and the peak with CO_2 was very weak. G.G.

N68-13483# Atomic Energy Commission, Washington, D. C. Div. of Research.
SUMMARIES OF PHYSICAL RESEARCH IN PHYSICS AND MATHEMATICS
Apr. 1967 412 p
(TID-4005, Pt. 3; TID-4005, Pt. 4)

Atomic Energy Commission supported research programs are reviewed. Work reported on was carried out during fiscal year 1966 at AEC laboratories, other government agencies, universities, and industrial laboratories. Brief descriptions are presented for: (1) medium energy physics research including design and development of devices, operations, and meson factory design studies; (2) low energy physics work including nuclear physics, atomic and classical physics, and stable and heavy nuclides; and (3) mathematics and computers research. Author and subject indexes are provided. E.C.

N68-13487# Naval Radiological Defense Lab., San Francisco, Calif.
THE MOMENTS METHOD USED TO DETERMINE THE ENERGY ALBEDO OF GAMMA RAYS FROM CESIUM-137 IMPINGING ON ALUMINUM AND IRON BARRIERS
Charles V. Smith and Norman E. Scofield 6 Sep. 1967 36 p refs
(USNRDL-TR-67-120; AD-661459)

The moments method, as outlined by Spencer and Fano, was used to calculate the differential angular energy distributions of gamma ray fluxes backscattered from semi-infinite media. A plane normal source is simulated in the calculation. The data in this report are specifically for the angular energy distributions of .662 MeV gamma rays from Cs137 backscattered from semi-infinite media of aluminum and iron. The angles of detection are 110, 120, 130, 140, 150, and 160 degrees. The data presented in tabular form. A graphical comparison is also shown between results from an albedo experiment and the moments method. All of the moments method data were obtained from a computer program developed at NRDL using moments generated at the National Bureau of Standards. Author (TAB)

N68-13606 European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1967 CERN SCHOOL OF PHYSICS, VOLUME 1
Jan Nilsson and Maurice Jacob 15 Sep. 1967 161 p refs Conf. held in Rattvik (Sweden), 21 May-3 Jun. 1967
(CERN-67-24, V. 1)

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1. THE DISCRETE SYMMETRIES P, C AND T J. Nilsson (Goteborg Univ.) 119 p refs (See N68-13607 04-24)

2. WEAK INTERACTIONS AND HIGH SYMMETRIES M. Jacob (Commissariat a l'Energie Atomique) 36 p refs (See N68-13608 04-24)

N68-13607 Goteborg Univ. (Sweden). Inst. of Theoretical Physics.
THE DISCRETE SYMMETRIES P, C AND T
Jan Nilsson *In* CERN Proc. of the 1967 CERN School of Phys., Vol. 1 15 Sep. 1967 119 p refs (See N68-13606 04-24)

Basic formalism and invariance principles are briefly reviewed with emphasis on discrete symmetries P (space reflections), C (charge conjugation), and T (time reversal) in elementary particle analyses. The concept of symmetry is introduced and some of the immediate implications which follow from invariance principles are developed by giving their various actions on certain state vectors. It is shown that a space reflection operator requires a Hilbert space larger than the physical Hilbert space since occasionally non-physical vectors appear. The concept of a total Hamiltonian subjected to some limiting procedure, so that the weak and the electromagnetic part of the Hamiltonian vanish, makes it conceivable to obtain a model which exhibits full C and P symmetry; the corresponding quantum mechanical operator would then not contain any parts which lead out of the Hilbert space when they act on a physical state vector. This limited Hamiltonian will be invariant under new transformations which render the C and P transformations ambiguous. In the example considered, this is the electric charge. A different C,P, and T transformation is possible corresponding to the limited strong, electromagnetic and weak interactions. G.G.

N68-13608 Commissariat a l'Energie Atomique, Saclay (France). Service de Physique Theorique.
WEAK INTERACTIONS AND HIGHER SYMMETRIES
Maurice Jacob *In* CERN Proc. of the 1967 CERN School of Phys., vol. 1 15 Sep. 1967 36 p refs (See N68-13606 04-24)

The consequences of higher symmetries in weak particle interaction processes are discussed for the SU(3) × SU(3) symmetry group. This higher symmetry brings together the unitary symmetry of strong interactions and the vector-axial symmetry of weak interactions; basic relations are introduced through semi-leptonic interactions of weak hadronic currents. Current algebra is used to derive the Adler–Weisberger relation, which gives the renormalization constant for the β-decay axial coupling in terms of a sum rule over π-nucleon cross sections. Current algebra combined with the partially conserved axial current hypothesis gives the first derivative of the π-nucleon forward elastic scattering amplitude limited to zero incident energy. Some general properties of the π-nucleon amplitudes can then be used to find a sum rule by means of dispersion integral, thus reaching the Adler–Weisberger sum rule in its usual form. G.G.

N68-13615# Parametrics, Inc., Waltham, Mass.
GENERATION AND PRACTICAL USE OF MONOENERGETIC X-RAYS FROM ALPHA EMITTING ISOTOPES Annual Report, Dec. 1965–Dec. 1966
Bach Sellers, John Papadopoulos, and Henry Wilson Feb. 1967 70 p refs
(Contract AT(30-1)-3491)
(NYO-3491-2) CFSTI: HC $3.00/MF $0.65

A study of the application and generation of monochromatic alpha-excited X-rays has been continued in this work. The research reported includes evaluations of various alpha sources, their mountings and environmental aspects of the generation method. The use of various types of proportional counters as detectors is discussed. Applications studied include alloy analysis, lubricating oil contaminant analysis, trace identification, and two-element mixture analysis. Several yield measurements are reported and compared with proton excited X-ray yields. Several potential applications, including analysis of extraterrestrial surfaces, are discussed. Author

N68-13635# Illinois Univ., Urbana. Dept. of Physics.
A FIXED U SUM RULE FOR PSEUDOSCALAR–BARYON SCATTERING
Philip B. James [1967] 9 p refs
(Contract N00014-67-A-0305-0005)
(AD-661849)

A superconvergence relation is derived for backward pseudoscalar-baryon scattering which is valid if not more than one odd signature baryon trajectory is in the region $-1/2 < \alpha \leq$ alpha(0) $< 1/2$. The superconvergent amplitude is a linear combination of the invariant amplitudes and is determined by the residue function of the leading baryon trajectory. An example is discussed in which the sum rule is used to estimate the phase of the residue function of such a trajectory for small negative u. Author (TAB)

N68-13646 European Atomic Energy Community, Ispra (Italy).
APPLICATION OF THE CHARACTERISTICS METHOD TO THE BOLTZMANN LINEAR INTEGRO-DIFFERENTIAL EQUATION, SOME NUMERICAL EXPERIMENTS [APPLICAZIONE DEL METODO DELLE CARATTERISTICHE ALL'EQUAZIONE INTEGRO-DIFFERENZIALE LINEARE DI BOLTZMANN–ALCUNE ESPERIENZE NUMERICHE]
M. L. Demuru 1967 73 p refs In ITALIAN, ENGLISH summary
(EUR-3632.I) CFSTI: $3.00

The method of characteristics is applied to the linear integro-differential equation of Boltzmann in one- and two-dimensional geometries. In this report some numerical results are given in order to compare the method of characteristics with Carlson's S_n method. Author

N68-13743# Iowa State Univ. of Science and Technology, Ames.
THE DE HAAS–VAN ALPHEN EFFECT AND THE FERMI SURFACE OF IRON
Peter Theodore Panousis (Ph.D. Thesis) Aug. 1967 125 p refs
(Contract W-7405-ENG-82)
(IS-T-175) CFSTI: HC $3.00/MF $0.65

A high-speed digital recording system has been incorporated into the impulsive-field de Haas–van Alphen experiment which, when used with a specially devised computer program, provides a significant increase in the frequency resolution of this experiment and at the same time enormously decreases the time required for analysis of the results. This data recording and analysis system was used to study the de Haas–van Alphen effect in iron whiskers with impulsive fields of up to 220 kG. The results have been interpreted in terms of two sets of surfaces, one set for spin-up electrons, which is in fair agreement with band calculations, and another set for spin-down electrons, which differs considerably from the surface predicted by band calculations. This model has been shown to account for the results of recent magnetoresistance and Hall effect measurements in iron. Author (NSA)

N68-13747# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
LINAC PHASE ERROR CALCULATIONS
D. Carter (San Jose State College, Calif.) 30 Aug. 1967 10 p refs
(BNL-11817; AGSCD-21) CFSTI: HC $3.00/MF $0.65

Distributed phase shifts in the resonant cavities of the AGS Conversion linear accelerator are investigated. Dispersion relations and fields are expressed for stabilized cavities, and phase distribution for the AGS Conversion linear accelerator are calculated. NSA

N68-13758# Stanford Univ., Calif. Linear Accelerator Center.
CURRENT ALGEBRA AT SMALL DISTANCES
J. Bjorken Aug. 1967 45 p refs Presented at the Intern. School of Phys. Enrico Fermi, Course 41, "Selected Topics in Particle Phys.", Varenna, Italy, 17–29 Jul. 1967
(Contract AT(04-3)-515)
(SLAC-PUB-338) CFSTI: HC $3.00/MF $0.65

A discussion of the effects of the application of the same current algebra for local current densities in quantum electrodynamics as for the charges is given. The kinematics of lepton scattering processes is discussed, and a sum rule is derived for neutrino processes, and from it a corollary for electron-scattering processes. An interpretation in terms of elementary constituents of the nucleon is suggested. Using this interpretation more predictions for inelastic lepton scattering are made, and these are compared with

experimental data. Finally, the radiative corrections to the Fermi part of beta decay are discussed, and it is argued on the basis of the local algebra that these corrections diverge logarithmically, just as for point charges. NSA

N68-13765*# Virginia Univ., Charlottesville. Dept. of Aerospace Engineering and Engineering Physics.
THE INTERACTION OF OXYGEN ATOMS WITH SOLID SURFACES AT EV ENERGIES Semiannual Status Report, 1 Jun.–30 Nov. 1967
G. D. Magnuson, J. W. Boring, and R. R. Humphris Dec. 1967 8 p
(Grant NGR-47-005-077)
(NASA-CR-91520; EP-4011-101-67U) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A research program is reported, which is designed to investigate the mass spectrum resulting when oxygen atoms, moving with satellite velocities, strike a solid surface. Primary objectives of the program are to increase knowledge concerning particle–surface interactions at energies corresponding to satellite velocities, and to provide information that will aid in the interpretation of mass spectrometric studies of the neutral constituents of the earth's upper atmosphere. Efforts devoted to design and construction of the vacuum system, ion source, focusing electrodes, and the purchase of equipment, are reported. The ion source and magnetic mass analysis chamber were completed and are operable. O^- ion beams have been generated and transported through the neutralization chamber. The neutralizing cell was also completed and positioned in the neutralization chamber. New cyro-pump design concepts which will allow the desired target chamber pressure of 10^{-10} Torr, while eliminating the buffer chamber and reducing the distance between the neutralizing cell and the target, are described. A quadrupole mass analyzer for mass analysis of emerging surface particles in the target chamber was purchased. Preliminary studies of source operation when used for the production of negative ions, in particular O^- ions, are reported. Illustrated are the negative ion spectrum resulting when pure O_2 is used as the source gas, and the output ion spectrum when pure CO_2 is used as the source gas. S.C.W.

N68-13775# Brookhaven National Lab., Upton, N. Y. Accelerator Dept.
THEORETICAL ANALYSIS OF GRADIENT PERTURBATIONS IN THE AGS
S. A. Fulling (Princeton Univ.) and M. Month 6 Sep. 1967 22 p refs
(BNL-11818; AGSCD-23) CFSTI: HC $3.00/MF $0.65

The problem of a gradient perturbation in an AGS was previously put in the form of an integral equation for a 2×2 matrix. This matrix equation is reduced to an equation for a single complex quantity. This reduced equation is then used to obtain the betatron parameters to all orders in q, and is used for exact solutions for perturbations consisting of a finite series of point quadrupoles. NSA

N68-13802 Commissariat a l'Energie Atomique, Grenoble (France).
MOLECULAR PHYSICAL PROPERTIES OF HYDROGEN ISOTOPES AND THEIR ISOTOPIC ARRANGEMENTS [PROPRIETES PHYSIQUES MOLECULAIRES DES ISOTOPES DE L'HYDROGENE ET DE LEURS COMBINAISONS ISOTOPIQUES]
Louis Guizouarn May 1967 58 p refs In FRENCH
(CEA-BIB-87)

Experimental results relating to the physical properties of hydrogen isotopes in gaseous, liquid, and solid states are compiled. This bibliographic study, which represents data obtained for 30 years prior to April 1965, is presented under the headings of deuterium, tritium, and isotope arrangements. Transl. by M.W.R.

N68-13837# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
INELASTIC THERMAL NEUTRON SCATTERING
A. S. Johnston Jul. 1967 51 p refs
(WANL-TME-1640) CFSTI: HC $3.00/MF $0.65

A modern derivation of inelastic neutron scattering cross sections for polycrystalline solids in the harmonic approximation has been collected and is presented. The detailed balance condition is derived. The usefulness of the scattering law is discussed. Approximations made in the calculation of thermal kernels for neutron design are discussed. Current work on kernels is reviewed. Investigation of the variation of several parameters on the Debye model, especially the effective temperature for use in a gas model kernel calculations, is given. Author (NSA)

N68-13894 Tokyo Univ. of Education (Japan). Dept. of Physics.
HIGH ENERGY NN SCATTERING WITH LARGE MOMENTUM TRANSFER AND CHIRAL SU(2)×SU(2) SYMMETRY
Yasuo Hara [1967] 8 p refs
(TUEP-67-25)

Relations among high energy, large momentum transfer nucleon–nucleon scattering amplitudes are obtained by making use of the assumption that they are chiral SU(2)×SU(2) symmetric. By applying the conventional Regge pole model, which has been successful in reproducing small momentum transfer scattering ($|t| < m_N$), to large momentum transfer scattering ($s >> |t| > m_N$), we find that $\sigma(pn \to np;$ charge exchange$) << \sigma(pp \to pp)$ and that the polarization vanishes very rapidly as the energy increases ($o(s^{-2})$). Author

N68-13905# Columbia Univ., Irvington, N. Y. Nevis Labs.
MEASUREMENT OF THE CHARGE ASYMMETRY IN THE DECAY OF $K_L^0 \to \pi^\pm + e^\mp + \nu$
Sheldon Bennett, David Nygren, Harry Saal, Jack Steinberger, and John Sunderland 1967 14 p refs
(Contract AT(30-1)-1932)
(NEVIS-162; CU-1932-266; R-593) CFSTI: HC $3.00/MF $0.65

The charge asymmetry $\delta = (\Gamma_+ - \Gamma_-)/(\Gamma_+ + \Gamma_-)$ for the electron in the decay of the long-lived neutral kaon to pion, electron, and neutrino was measured. An asymmetry $\delta = (+2.24 \pm 0.36) \times 10^{-3}$ was found. The results shows that CP symmetry is violated in this process. Author (NSA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-12828*# Florida Univ., Gainesville. Dept. of Physics and Astronomy.
LOW-FREQUENCY COMPONENT ELECTRIC MICROFIELD DISTRIBUTIONS IN PLASMAS
C. F. Hooper, Jr. [1967] 25 p refs Supported in part by Res. Corp., New York
(Grant NSG-542)
(NASA-CR-91295) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Low-frequency component electric microfield distributions in a plasma are calculated at both a neutral and charged point. It is shown that this calculation allows for the inclusion of all correlations to a high degree of accuracy. The theory is compared with the Holtsmark and Baranger–Mozer theories. A detailed analysis of all approximations is included, together with a Monte Carlo study. Numerical results are shown both graphically and in tabulated form. Author

N68-12855* National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE TEMPERATURE AND CROSS-SECTIONAL SHAPE OF AN ELECTRIC-ARC COLUMN MOVING ALONG PARALLEL ELECTRODES IN A MAGNETIC FIELD [ISSLEDOVANIYE TEMPERATURY I FORMY POPE-RECHNOGO SECHENIYA STOLBA ELEKTRICHESKOY DUGI, DVIZHUSHCHEYSYA V MAGNITNOM POLE PO PARAL-LEL'NYM ELEKTRODAM]

D. I. Slovetskiy Nov. 1967 13 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur, Akad. Nauk SSSR (Moscow), v. 5, no. 3, 1967 p 401–409
(NASA-TT-F-11445) CFSTI: $3.00 CSCL 20I

The temperature field and electron concentration in an electric arc with arc currents from 300 to 2000 amp are investigated in the case where the arc moves along parallel copper electrodes in air at atmospheric pressure under the effect of an applied transverse magnetic field ($H = 3.2 \times 10^4$ to 6.85×10^4 amp/m). Formulas for the rate of propagation and the intensity of the arc are derived, and photographs (obtained with a high-speed motion picture camera) showing the deformation of the cross section of the arc during its motion are presented. Measurements obtained with a photoelectric spectrometer show that the arc temperature equals 12,300°K. increasing near the electrode to 14,000 to 15,000°K. Author

N68-12863# United Kingdom Atomic Energy Authority, Culham (England). Research Group.

A STUDY OF THE END LOSSES FROM A THETA PINCH USING PIEZOELECTRIC PRESSURE PROBES

H. A. B. Bodin and C. A. Bunting Jan. 1967 11 p refs
(CLM-R-70) HMSO: 1s 9d

In order to investigate the plasma escaping axially from the end of a theta pinch coil, a fast piezoelectric pressure probe with a rise time of 0.5 μ sec was designed and constructed. The probe incorporates a thin piezoelectric crystal mounted in a quartz rod, with one end projecting axially into the plasma. Plasma pressure distribution was measured for discharges trapping parallel and reversed flux. The results are discussed in terms of various theoretical models. For the experimental conditions in which the radial electric field in the sheath is small due to short circuiting at the ends, the theory predicts a loss hole of 1.5 mm radius in reasonable agreement with the experimental value. M.G.J.

N68-12880*# Florida Univ., Gainesville. Dept. of Physics and Astronomy.

ELECTRON CORRELATIONS IN PLASMA LINE BROADENING.

Earl W. Smith [1967] 33 p refs
(Grant NsG-542)
(NASA-CR-91284) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A method of including electron correlations in the relaxation theory for spectral line broadening plasmas is presented. The effect of these correlations in the relaxation theory is compared with the analogous results in the impact theory; specifically, it is shown that the impact parameter cutoff used in the impact theory constitutes a very good approximation to the effect of these correlations.
Author

N68-12887# Army Electronics Labs., Fort Monmouth, N. J.

EFFECT OF TIME-VARYING ELEVATED GAS TEMPERATURES ON PLASMA TRANSPORT LOSSES IN HELIUM AFTERFLOWS

Gunthard K. Born May 1967 18 p refs
(ECOM-2850; AD-659771)

The temperature dependence of ambipolar diffusion in helium afterglow plasmas is investigated at gas temperatures between 1200K and 2500K. The heating of the gas and the excitation of acoustic waves by pulsed discharges are utilized to generate and measure the elevated temperatures. The electron density decay is measured with microwaves. The effects of the inhomogeneous temperature distribution and of convection due to the cooling of the gas are discussed, and recombination losses are taken into account. The experimental plasma decay rates support the theoretical temperature dependence of the diffusion coefficient. Author (TAB)

N68-12911 Aeronautical Research Council (Gt. Brit.)

THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PART 3: ARCS IN TRANSVERSE MAGNETIC FIELDS AT ATMOSPHERIC PRESSURE

V. W. Adams London HMSO Dec. 1965 83 p refs Supersedes RAE-TR-65273; ARC-28072 See N67-22947
(ARC-CP-959; RAE-TR-65273; ARC-28072) HMSO: 15s

Experimental results in air at a pressure of one atmosphere on the behavior of arcs under the action of applied magnetic fields are given for two electrode materials (graphite and brass) and different electrode configurations. These results extend earlier work to larger electrode path lengths on graphite and brass, and also include results for a pair of long straight electrodes. The range of arc current has been extended to 3700 amps and the applied magnetic field to 0.49 Wb/m^2 for experiments on a pair of straight electrodes. The results are analyzed using a simple model for the arc motion assuming that the arc behaves in the same way as a body in a gas stream. Some comments are made on a major difference between results for brass and graphite electrodes. Arc drag areas are calculated for results where the arc wake does not affect the motion and are found to be about one half of the maximum luminous frontal areas of the arc determined photographically. Finally, the results are analyzed according to a theory for convection-stabilized arc columns. Author

N68-12943# Naval Ordnance Lab., White Oak, Md.

ELECTRON DENSITY OF AIR BEHIND A REFLECTED SHOCK WAVE

Philip M. Aronson and David Levine 5 Jan. 1967 18 p refs
(NOLTR-67-139; AD-661805)

The electron density of air in the region behind a reflected shock wave was studied experimentally and compared with values obtained from thermodynamic calculations. The measurement of electron density was made with a microwave system which monitored the power transmitted through the plasma. Measured values of electron density were found to be higher than those predicted from thermodynamic considerations. Author (TAB)

N68-12969 Royal Aircraft Establishment, Farnborough (England).

THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PART 5: ARCS AT PRESSURES UP TO 18 ATMOSPHERES IN ANNULAR GAPS

V. W. Adams Apr. 1967 21 p refs
(RAE-TR-67089, Pt. 5)

Experimental results are presented for electric arcs rotating round an annular gap between carbon electrodes in a pressure vessel with a throughput of nitrogen. The arc velocity is shown to depend on the ambient pressure for pressures up to 18 atmospheres. Some results for arcs rotating in an annular gap at atmospheric pressure with additional air flows through the gap are also given. In this case water-cooled brass electrodes are used. The rotational arc velocity is shown to be reduced by small flows to about 1/2 the value with no flow. Initial difficulties at high pressure and the effects of small axial flows are regarded as significant for arc heaters and are described in detail. Author

N68-12997 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
PLASMA CONFINEMENT WITH SPHERICAL MULTIPOLE FIELD [ORGANICZANIE PLAZMY SFERYCZNYM MULTIPOLEM MAGNETYCZNYM]
Marek Sadowski 1967 12 p refs Submitted for publication
(INR-836/XVIII/PP)

Application of a spherical high-order multipole as a plasma magnetic trap is considered, and various spherical multipoles are described. The approximate formula for particle losses from the icosahedron-geometry trap, as well as comments on the experimental arrangement realized, are given. Author

N68-13090 Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PART 4: ARCS MOVING ALONG STRAIGHT PARALLEL ELECTRODES
V. W. Adams Mar. 1967 44 p refs
(RAE-TR-67077, Pt. 4)

Earlier work with the self-field due to the arc current in the electrodes in the same direction as the applied magnetic field has been extended to include results with fields up to 1.0 Wb/m^2. Results are also given for three electrode materials with electrical connections arranged so that the self-field is eliminated, and are shown to differ from those where the self-field is present and approximately calculated. A method, employing similarity parameters, of collating data on arc motion in transverse magnetic fields is used for comparative evaluation. Arc motion with a low velocity imposed air flow along and relative to the electrodes has been studied, and the simple notion that the algebraic difference between the arc velocities relative to the electrodes in still and moving air is equal to the imposed air velocity is found to be only approximately true when the air stream acts against the arc motion. Author

N68-13142*# Stanford Univ., Calif. Inst. for Plasma Research.
THEORETICAL AND EXPERIMENTAL STUDIES OF THE NATURE AND CHARACTERISTICS OF SPACE-RELATED PLASMA RESONANCE PHENOMENA Semiannual Report, 1 Nov. 1966–30 Apr. 1967
F. W. Crawford May 1967 38 p refs
(Grant NGR-05-020-077)
(NASA-CR-91335; SU-IPR-167; SAR-4) CFSTI: HC $3.00/MF $0.65 CSCL 20I

In the theoretical studies, emphasis was placed on establishing the properties of cyclotron harmonic waves (CHW) propagation in a magnetoplasma with a spherical shell electron velocity distribution. The appropriate dispersion characteristics are discussed, and the results are compared with those for a cylindrical shell distribution. The results are considered significant in that an anisotropic, monoenergetic, velocity distribution will relax to a spherical shell if electron–neutral momentum transfer collisions occur; a modification and probable weakening of the strong instabilities associated with an anisotropic distribution will then occur. Equations are also derived to describe obliquely propagating modes in a magnetoplasma with an isotropic Maxwellian distribution. Experimental techniques are discussed for measuring oblique propagation (Maxwellian distribution) and perpendicular propagation (spherical shell distribution). The possibility of applying resonance rectification phenomenon to plasma diagnostics is mentioned. M.G.J.

N68-13173 Royal Aircraft Establishment, Farnborough (England).
NUMERICAL CALCULATIONS OF THE PROPERTIES OF AXIALLY SYMMETRIC ARC COLUMNS
A. Wells Mar. 1967 45 p refs
(RAE-TR-67076)

Numerical solutions of the energy balance equation of an axially symmetrical uniform arc column are outlined and illustrated with results pertaining to a nitrogen plasma at atmospheric pressure. Published data on the electrical conductivity, thermal conductivity and radiated power density of nitrogen plasmas have been reviewed. The data selected for subsequent calculations of arc properties are summarized in tables. Using the selected data, temperature distributions (T(r)), arc radii (R), arc currents (I) and radiation losses (U), are calculated for arc columns in which the axial temperature, T_o, and the voltage gradient, E, have been specified. Results are summarized by a series of graphical plots of arc similarity parameters I/ER^2, U/R^2, $EI-U$, against the axial temperature, T_o. Author

N68-13174 Royal Aircraft Establishment, Farnborough (England).
THE INFLUENCE OF GAS STREAMS AND MAGNETIC FIELDS ON ELECTRIC DISCHARGES. PART 6: THE SHAPE OF ARCS MOVING BETWEEN PARALLEL STRAIGHT ELECTRODES IN UNIFORM AND NON UNIFORM FIELDS
A. H. Mitchell Mar. 1967 35 p refs
(RAE-TR-67074)

Arc shapes are calculated for arcs moving between parallel straight electrodes and driven by magnetic fields which are normal to the plane containing the electrodes. Two cases are considered: (i) uniform field and (ii) a field increasing in strength from one electrode to the other. The forces acting on the arc are taken to be (a) a Lorentz force, (b) a "drag" force, (c) a force resulting from entrainment or discharge of gas by the arc, and (d) a centrifugal force. The shapes calculated are compared with experimental arcs moving under the influence of corresponding fields. Author

N68-13288*# Stanford Univ., Calif. Inst. for Plasma Research.
NONUNIFORM ELECTRICAL CONDUCTION IN MAGNETOHYDRODYNAMIC CHANNELS
David A. Oliver May 1967 181 p refs
(Contracts NAS3-6261; AF 49(638)-1695)
(NASA-CR-91557; SU-IPR-163; AFOSR-67-2651; AD-661586) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Methods of describing steady electrical conduction in a partially ionized gas with Hall effect, strong applied or magnetically induced electric fields, and a nonuniform electrical conductivity are proposed. One of these methods is based on model conductivity distributions, and the other is based on a nonequilibrium conductivity and incorporates the electron energy and ionization equations. The occurrence of a nonequilibrium conductivity leads to the development of an ionization instability. It is shown that the steady equations with a nonequilibrium conductivity are of mixed elliptic-hyperbolic type and that the condition for the uniform ellipticity of these equations is identical to the condition for the prevention of the ionization instability. These methods are applied to flowing gases in two-dimensional linear magnetohydrodynamic channels with segmented electrode structures. Detailed numerical solutions for current and potential are obtained. In general, it is found that conductivity nonuniformities lead to a degradation of performance as reflected in increased internal impedance of the conducting gas and depressed Hall voltage. Theoretically obtained distributions of current on electrodes in contact with a nonuniformly conducting gas are found to be in accord with experimental measurements. Author (TAB)

N68-13370# Oak Ridge National Lab., Tenn.
HYDROMAGNETIC STABILIZATION OF JET-DRIVEN VORTEX FLOW
J. J. Keyes, Jr., T. S. Chang, and W. K. Sartory Oct. 1967 72 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1896) CFSTI: HC $3.00/MF $0.65

Experiments are described which demonstrate the stabilizing influence of an axial magnetic field (up to 75 kilogauss) on vortex flow of an aqueous electrolytic conductor generated by two-dimensional, tangential wall jets. For example, using a 10-cm-dia vortex tube having two feed jets and a single exit orifice at the center of one end, the tangential Reynolds modulus at transition to instability was increased from 500 with no magnetic field to 7600 with the 75 kilogauss field (corresponding to a Hartmann modulus based on the tube radius of 172). The experimental magnetic stabilization results for 1-, 2-, and 4-slit injection are correlated in terms of a modified Goertler modulus [tangential Reynolds modulus based on momentum boundary-layer thickness times (momentum thickness/radius)$^{0.43}$] and the Hartmann modulus based on momentum thickness. An MHD Goertler-type stability analysis based on a tangential jet-injection velocity profile over a concave wall is considered. The fluid medium is assumed to be incompressible, viscous, and electrically conducting. The stationary jet-injection velocity profile is calculated according to the classical theory of laminar boundary-layer flow, neglecting effects of curvature. The stability analysis is carried out numerically based on the linear perturbation theory for the calculated stationary profile subjected to an external magnetic field. Author (NSA)

N68-13380 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Stuggart (West Germany). Inst. fuer Energiewandlung und Elektrische Antriebe.

ON THE MOTION OF CHARGED PARTICLES IN TIME-DEPENDENT HOMOGENEOUS AND INHOMOGENEOUS MAGNETIC FIELDS WITH AXIALASYMMETRY [PUNKCLADUNGEN IN ZEITABHAENGIGEN HOMOGENEN UND INHOMOGENEN AXIAL SYMMETRISCHEN MAGNETFELDERN]

A. Meert Sep. 1967 45 p refs In GERMAN; ENGLISH summary
(DLR-FB-67-58)

The nonrelativistic motion of charged particles is described in time-dependent homogeneous and inhomogeneous magnetic fields with consideration of the induced electrical alternating fields. Generally, this leads to a system of coupled differential equations which can only be solved numerically. In the homogeneous time-dependent magnetic field, however, analytical solutions exist, but only for particular values of the parameter. These analytical solutions are determined. Some numerically calculated applications for homogeneous as well as inhomogeneous (with rotational symmetry, however) periodically variable magnetic fields are given. Author

N68-13389# Technische Hochschule Munchen (West Germany). Elektrophysikalisches Inst.

METHODS FOR DETERMINATION OF TRANSPORT COEFFICIENTS FROM HIGH POWER ARCS Final Scientific Report, 1 Oct. 1962–31 Jan. 1967

Heinz Maecker 12 Oct. 1967 50 p refs
(Contract AF 61(052)-649)
(ARL-67-0219; AD-661995)

Analytical methods and instruments were developed to aid in the study of transport coefficients in nitrogen, hydrogen, and argon arcs at temperatures above 15,000K. The transport properties considered were electrical conductivity, heat flux potential, thermal conductivity, and specific radiation. TAB

N68-13469# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

PLASMA PHYSICS

G. Bekefi, W. P. Allis, S. C. Brown, J. C. Ingraham, B. L. Wright et al *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 53–71 ref (See N68-13461 04-23)
(Contract AT(30-1)-1842)

The following studies are presented: (1) *Radiofrequency Absorption in Plasmas*—interaction of RF fields with magneto-active plasma columns and resultant impedance changes of the coil; (2) *Bremsstrahlung From a Highly Turbulent Plasma at Harmonics of the Plasma Frequency*—calculations of bremsstrahlung at any harmonic in terms of turbulent spectrum; and (3) *Diffusion Wave Experiment*—direct current arc properties and arc geometry for exciting one-dimensional radial diffusion waves. G.G.

N68-13470# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.

PLASMAS AND CONTROLLED NUCLEAR FUSION

L. D. Smullin, A. Bers, R. J. Briggs, and R. R. Parker *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 73–134 ref (See N68-13461 04-23)
(Grant NSF GK-1165)

Principle results in plasma and nuclear fusion studies are given for: (1) *System C*—excitation of ion-cyclotron waves by applying RF voltage to coil wound concentric with plasma column; (2) *Computer Models of the Beam-Plasma Interactions*—models with a uniform plasma density for lossless one-dimensional beam plasma interaction, and Langmuir probe measurements of sinusoidal axial plasma density distribution; (3) *Thin Electron-Beam Interactions With Ions in a Plasma-Filled Waveguide*—rigid electron beam model for synchronous interactions, amplification rates for weak beam, and absolute instabilities; (4) *Alternative Stability Analyses*—pole-pinch method for distinguishing convective and absolute instabilities; (5) *Electron Beam With a Plasma*—theoretical analyses of infinite rigid strip beam and ion plasma; (7) *Low Field Microwave Emission From Contactless Indium Antimonide Samples*—broadband microwave emission from surface treated samples at different pulse lengths; and (8) *Hollow-Cathode Arc Plasma*—arc decay process at arc current removal. G.G.

N68-13516*# California Univ., San Diego.

PHYSICAL PROCESSES IN THE MAGNETOPLASMADYNAMIC ARC Semiannual Report, Mar.–Sep. 1967

R. Lovberg Nov. 1967 22 p
(Grant NGR-05-009-030)
(NASA-CR-91529; SAR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A detailed investigation of the current spoke was made during this period. More compact Rogowski coils were developed and used to make more detailed measurements of spatial distributions of current and potential, and thus define the spoke structure more clearly. Plasma flow velocities were detected in the spoke with biased electric probes. These measurements indicate that the plasma is moving azimuthally with the spoke and that the spoke exhibits some internal structure. A magnetohydrodynamic model of the spoke is being developed. R.N.A.

N68-13639# California Univ., Livermore. Lawrence Radiation Lab.

TRANSIENT DEVELOPMENT OF THE HOSE INSTABILITY

Richard J. Briggs (MIT—Cambridge, Mass.) 2 Mar. 1967 15 p refs
(Contract W-7405-ENG-48)
(UCID-15127) CFSTI: HC $3.00/MF $0.65

A method for determining the transient development of the hose instability of a tickled beam which allows easy generalization to see the effects of filtering the loop signals and tickling at frequencies other than optimum was presented. NSA

N68-13858 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MEASUREMENT OF THE MEAN ELECTRIC CONDUCTIVITY OF A STRONGLY IONIZED PLASMA BY THE RADIOFREQUENCY METHOD [IZMERENIYE SREDNEY ELEKTROPROVODNOSTI SIL'NOIONIZOVANNOY PLAZMY RADIOCHASTOTNYM METODOM]

A. D. Portnov, V. A. Ryabyy, and E. A. Yakovlev *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 159–167 refs (See N68-13841 04-28)

The possibility of measuring the mean electric conductivity of a strongly ionized plasma by the variation in the quality factor of the resonant circuit is discussed. In the experiment described, measurements were made of the positive column of a stabilized arc discharge burning in argon. A probe method was used for comparison with the data obtained from measuring the circuit. The results indicate that the mean electric conductivity can be determined by the circuit method on the basis of a solution for a long solenoid. Qualitative agreement was found between the measurement results of the circuit and probe methods. M.G.J.

N68-13902# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

MAGNETIC FIELD PROBE MEASUREMENTS OF PLASMA INSIDE A CONICAL THETA-PINCH

R. L. Small and E. A. Valsamakis Dec. 1967 6 p refs Presented at the AIAC Elec. Propulsion and Plasmadynamics Conf., Colorado Springs, 11–13 Sep. 1967
(RM-391J)

The local magnetic field in the plasma is measured inside the conical coil of a theta pinch. The measurements are obtained with a three directional magnetic probe in the presence of an external axial magnetic field of 0.26 Tesla. Energy is transferred into the argon plasma by the excitation of the conical coil. This excitation is crowbarred at the end of the first half cycle. The three magnetic field components measured are in the radial, azimuthal and axial direction. The plasma magnetic field is mapped throughout the entire conical coil region indicating the existence of several simultaneous plasma vortex structures inside the conical coil. These vortex structures are found close to the glass walls of the vacuum system containing the plasma. The average speed of the vortex structures were measured to be about 3×10^4 m/sec. The ion density measured by a cylindrical biased double probe was about $6\times10^{16}/cm^3$. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-12812# California Univ., Berkeley. Lawrence Radiation Lab. Inorganic Materials Research Div.

A TECHNIQUE FOR DRIFTING LITHIUM INTO GERMANIUM

David A. Jenkins Jan. 1967 12 p refs
(Contract W-7405-ENG-48)
(UCRL-17317) CFSTI: HC$3.00/MF$0.65

A method that was used successfully to drift Li into Ge is described. A large variation in the performance of samples taken from different ingots was found. For a given ingot the same results were obtained with different samples, so fluctuations in performance were attributed to the original ingot and not to variations in the techniques of fabrication. The lithium drift mechanism is also very sensitive to the presence of impurities. NSA

N68-12833 Osterreichische Studiengesellschaft fur Atomenergie G.m.b.H., Seibersdorf (Austria).

FINE STRUCTURE OF THE "FORBIDDEN BANDS" OF DEBYE-SCHERRER RINGS [FEINSTRUKTUR "VERBOTENER" DEBYE-SCHERRER-RINGE]

E. M. Hoerl [1967] 19 p refs In GERMAN; ENGLISH summary Submitted for publication
(SGAE-11/1967)

Electron diffraction patterns of a distorted MoS_2 foil which was rotated during exposition showed a fine structure of the "forbidden" Debye–Scherrer rings. Reflections in the shape of short lines occurred at inclined position with respect to the ring radii. An explanation based on double diffraction and the existence of stacking faults is presented. Author

N68-12856 Naval Ordnance Lab., White Oak, Md.

A SIMPLIFIED THEORY OF ANHARMONIC CONTRIBUTION TO THE THERMODYNAMIC PROPERTIES OF METALS

D. John Pastine 1967 6 p refs Presented at the Symp. on High Dyn. Pressure, Paris, 11–15 Sep. 1967

Anharmonic effects in the simple case of a body centered cubic lattice, which supports only pure longitudinal normal modes traveling parallel to the principal axis, are treated. The results are generalized to the case of a monatomic solid followed by applications to sodium metal. R.N.A.

N68-13015# Clevite Corp., Cleveland, Ohio. Electronic Research Div.

RESEARCH ON THE MECHANISM OF THE PHOTOVOLTAIC EFFECT IN HIGH-EFFICIENCY CDS THIN-FILM SOLAR CELLS Interim Technical Report, 1 Jun. 1966–31 May 1967

L. R. Shiozawa, George A. Sullivan, and Frank Augustine Wright-Patterson AFB, Ohio ARL Sep. 1967 94 p refs
(Contract AF 33(615)-5224)
(ARL-67-0190; AD-661557)

During the first year of this project Model 1066, an explanation of the mechanism responsible for the photovoltaic effect in thin-film CdS solar cells was developed. Emphasis has since been placed on critical experiments designed to test this model, and to establish cell parameters essential to further refinement of the model. Experiments which have been carried out include measurements of the thickness of the Cu2S layer, examination of the grain structure of the CdS layer, measurements of optical absorption in and examination of the crystallography and stoichiometry of the Cu2S layer, diffusion and solubility measurements for Cu in CdS, and measurements of junction capacitance, current-voltage characteristics and spectral response of CdS solar cells. In addition, a unique evaporation system has been developed and is being used successfully. Findings of these investigations have all been in general agreement with Model 1066, which involves light absorption by hole-electron pair generation in the p-type Cu2S layer, followed by diffusion of the minority electrons into a copper-compensated dark-insulating CdS layer, and collection of these at an i-n CdS homojunction. TAB

N68-13039# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF DEFORMATIONS OF LATTICE OF PARAMAGNETIC RESONANCE

N. G. Koloskova 1 Sep. 1967 35 p refs Transl. into ENGLISH from Paramagnitnyi Resonans, Sbornik Statei, 1964 p 115–133
(FTD-MT-65-572; AD-661442)

The effect of lattice deformations on the spectrum of paramagnetic resonance is theoretically studied. Investigated are: (1) shape of the absorption curve of magnetic and acoustic resonances in electronic and nuclear paramagnetics, due to local distortions of

the crystal lattice; it is shown that the line width is proportional to the square root of the density of dislocations and is a function of the mutual orientation of the external magnetic field of the crystallograph axes and dislocation lines; (2) the width and shift of electron paramagnetic resonance lines are caused by uniform deformations. A phenomenological description is proposed for the experiments on spin-lattice relaxation measurement. Author (TAB)

N68-13066# Naval Research Lab., Washington, D. C.
THERMAL AND ELECTRICAL RESISTIVITIES OF RHENIUM FROM 2°K TO 20°K
J. T. Schriempf *In its* Rept. of NRL Progr. Mar. 1967 p 1–5 refs Sponsored in part by ARPA (See N68-13065 04-34)

Measurements of the thermal and electrical resistivities of highly pure monocrystals of rhenium have been made at temperatures between 2°K and 20°K. The ideal resistivities can be described by $\rho_i \propto T^m$ (in the electrical case) and by $w_i \propto T^n$ (in the thermal case) only if m and n are allowed to vary with temperature. The values of m and n fall smoothly from 5.1 to 3.3, respectively, at 20°K and approach 2 and 1 at the lowest temperatures. The anisotropy is found to be approximately $\rho_{i\perp}/\rho_{i\parallel} \approx 1.3$ and $w_{i\perp}/w_{i\parallel} \approx 1.1$ at all temperatures. The low temperature limit of the data is interpreted by means of electron–electron scattering between parabolic s and d bands. Author

N68-13069# Naval Research Lab., Washington, D. C.
THERMOLUMINESCENT DOSIMETERS OF LITHIUM BORATE
E. J. West, A. E. Nash, F. H. Attix, R. D. Kirk, and J. H. Schulman *In its* Rept. of NRL Progr. Jun. 1967 p 1–6 refs Sponsored in part by AEC (See N68-13068 04-34)

It has been suggested previously that manganese-activated lithium borate might be applicable for use in medical therapy dosimetry in place of lithium fluoride. Recently various modifications in preparation procedures have been tried, notably the substitution of each of eleven other activators for manganese, but none of them approached its effectiveness. Batch variations have been virtually eliminated by increasing bath size to 75 grams and using platinum ware exclusively. The main drawback of lithium borate in dosimeter applications has been the supralinearity of its response-*versus*-exposure curve above about 200 roentgens. Exploratory measurements have been made to improve the linearity by means of prior irradiation and annealing treatments, and the method has been found to optimize this procedure. The cause of the sensitivity enhancement in lithium borate has been found to be the creation, by radiation damage, of new energy traps which give rise to a thermoluminescent glow peak at about 220°C. The response (per roentgen) of this phosphor has been measured from 40 to 170 kev and compared with that for Co^{60} γ rays. Results show greater responsiveness to X rays than predicted on the basis of energy absorption coefficients; further investigation is indicated. Author

N68-13113# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
THE CONVERSION OF CUBIC TO HEXAGONAL SILICON CARBIDE AS A FUNCTION OF TEMPERATURE AND PRESSURE
Charles E. Ryan, Robert C. Marshall, John J. Hawley, Irvin Berman, and Dennis P. Considine Aug. 1967 28 p refs *Its* Physi. Sci. Res. Papers, No. 336
(AFCRL-67-0436; AD-661563)

Polytypism in silicon carbide is reviewed. The geometric properties of close-packed hexagonal structures are illustrated by models of the stacking arrangements in the more common polytypes. The inadequacies of a number of theories on the origin of polytypes are briefly discussed, and it is concluded that no satisfactory theory exists. From the results of recent AFCRL experiments in the temperature range of 2100 to 2800C, it is concluded that the transformation of beta to alpha silicon carbide can be suppressed by 20 atm of inert gas, and consequently that the alpha silicon carbide is a defect structure probably involving deficiencies in the carbon sublattice. It is further concluded that both polytypism and the beta-alpha transformation are impurity-dominated and that the most significant impurities are boron and nitrogen. Speculating on the origin of polytypes, it appears that any adequate theory must include the influence of chemical and physical imperfections, temperature, and ambient gas composition and pressure. Author (TAB)

N68-13120# United Kingdom Atomic Energy Authority, Harwell (England).
SOLID STATE PHYSICS DIVISION Progress Report, Sep. 1965–Feb. 1966
Apr. 1966 63 p refs
(AERE-PR/SSP-10)

Summary data are presented on continuing progress in solid state physics. The major areas reported on are: metal physics, damage and defects in solids, neutron crystallography, neutron scattering, and pile neutron research. Information is also included on the expanded collaboration between the solid state physics division and various university research facilities. E.J.S.

N68-13234# Illinois Univ., Urbana. Materials Research Lab.
MATERIALS SCIENCES RESEARCH Annual Technical Report, 1965–1966
1 Nov. 1966 158 p refs
(Contract ARPA SD-131)

Progress reports are presented for the 42 projects conducted by the University of Illinois' Materials Research Laboratory, and various personnel activities and facilities of the laboratory are noted. The laboratory, which is an interdepartmental and interdisciplinary laboratory, within the College of Engineering, is operated in conjunction with the departments of ceramic engineering; chemistry and chemical engineering; electrical engineering; mining, metallurgy; and petroleum engineering; and physics. The projects conducted reflect the varied interests of these departments. M.W.R.

N68-13236* National Aeronautics and Space Administration, Washington, D. C.
DEFINITION OF SURFACE—PROPERTIES OF METALLIC SURFACES PREPARED IN AN ULTRA-VACUUM [QU'EST-CE QU'UNE SURFACE? PROPRIETES DES SURFACES METALLIQUES PREPAREES DANS L'ULTRAVIDE]
G. A. Boutry Dec. 1967 21 p Paper Presented at the Intern. Conf. on Extreme States of the Matter at Very High and Very Low Temp. and Very High and Very Low Pressures, Paris, 1967
(NASA-TT-F-11423) CFSTI: $3.00 CSCL 20L

Contact and lubricated friction, absorption and chemical sorption, temperature and pressure are considered in relation to the properties of metallic surfaces that are prepared in ultrahigh vacuum atmospheres. Attention is given to the necessity of using an ultrahigh vacuum to study virgin metallic surfaces. Attempts at preparing monocrystalline surfaces in a vacuum are discussed, as is the photoemission of nonpolluted metal surfaces. Use of osmium cathodes is also described, along with the extraction function of such transpiration cathodes. M.W.R.

N68-13249# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF THE PHENOMENA OF HOT ELECTRONS IN SEMICONDUCTORS AT VERY LOW TEMPERATURES [CONTRIBUTION A L'ETUDE DES PHENOMENES D'ELECTRONS CHAUDS DANS LES SEMI-CONDUCTEURS A TRES BASSE TEMPERATURE]
Albert Zylbersztejn Serv. de Doc. Sci. et Tech. de l'Armament 1967 102 p refs In FRENCH Its No. NT-158
CFSTI: $3.00

Theoretical and experimental evidence is presented on different effects of hot electrons, bound by charge carrier concentration, in semiconductors at very low temperatures. Negative magnetoresistance is observed for these hot electrons in silicon, and a theory is given to explain the avalanche phenomenon at low temperature. A dimensional effect in the conductivity of germanium and indium antimonide is related to the perturbation of phonons by the hot electrons. A cryostat is described that can regulate temperature to 0.1°K in the neighborhood of 20°K.
Transl. by M.W.R.

N68-13253# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Microwave.
CONDUCTIVITY OF INTRINSIC InSb IN HIGH ELECTRIC FIELDS
P. Weissglas and K. Blotekjaer 6 Jul. 1967 25 p refs
(Contract AF 61(052)-895)
(RADC-TR-67-607; SR-19; AD-661576)

A theory is developed for the carrier transport properties and impact ionization rate in an intrinsic polar semiconductor with high carrier density. Polar scattering prevails in weak fields but it is shown that intercarrier interactions become important at higher field strengths. The carrier concentration is found to vary approximately exponentially with applied field. Numerical results for data representative of InSb are presented. Author (TAB)

N68-13261*# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
GENERATION AND DETECTION OF VERY HIGH FREQUENCY ACOUSTIC WAVES IN SOLIDS Final Report
J. De Klerk, J. H. Parker, Jr., R. W. Weinert, and P. G. Klemens 15 Sep. 1967 84 p refs
(Contract NAS8-18023)
(NASA-CR-91338) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Techniques were first developed for detecting phonons in the range of 1–3 GHz by optical Bragg scattering. In this case the phonons were generated by thin film transducer techniques and interferometric methods were used for separating the frequency shifted light component. Concurrently, a Q-spoiled CO_2 laser was developed for phonon generation. This laser yielded ten infrared lines with a total peak power of 100 KW. It was estimated that at this power level the laser could initiate an acoustic wave with a strain amplitude of 10^{-6} through electrostrictive action at the surface of a crystal. The above techniques were then combined in an attempt to generate and detect phonons in α-Al_2O_3 at 54 GHz. The results of this first try have, so far, been negative. The reasons for the negative results are discussed along with the future direction of the program. A theoretical study was carried on concurrently with the above experimental work and was concerned with attenuation of high-frequency phonons in solids at low temperatures. This work has demonstrated that the acoustic attenuation will vary as the fifth power of frequency and will be quite small below 10^{12} Hz. Author

N68-13280* Rice Univ., Houston, Tex. Dept. of Space Science.
THE TEMPERATURE AND PRESSURE DERIVATIVES OF ISOTROPIC SOUND VELOCITIES OF α-QUARTZ
Naohiro Soga Jan. 1968 10 p refs Submitted for publication
(Grant NsG-6-59)
(NASA-CR-91303) CFSTI: $3.00 CSCL 20L

Variation of approximately average shear velocity with pressure and temperature is found to be anomalous; and the most probable values of isotropic sound wave velocities at various pressures and temperatures were obtained from single crystal wave velocities of alpha-quartz. Temperature and pressure derivatives of isotropic wave velocities and bulk modulus were estimated from best-fit seventh-degree polynomials for the pulse repetition frequencies for each wave as a function of temperature, two equations for the linear thermal expansion of the X and Z axes, and pressure derivatives of single crystal elastic constants of alpha-quartz. Computer calculations were used to produce a table of longitudinal wave velocity, shear wave velocity, and adiabatic bulk modulus for various temperature and pressures. M.W.R.

N68-13306# Cornell Univ., Ithaca, N. Y. Materials Science Center.
ESR AND OPTICAL STUDIES OF O_2^- IN NaF
M. L. Meistrich Oct. 1967 27 p refs
(Contract Nonr-401(54))
(TR-5; MSC-815; AD-661856)

The O2(-) molecule-ion was observed as an impurity in single crystals of sodium fluoride. The ion was produced principally by room temperature x-irradiation of NaF doped with OH(-) ions. The O2(-) ion was identified by its ESR spectrum, observed at liquid helium temperatures. The g-tensor for the resonance has approximate axial symmetry about the molecular axis, with g-parallel = 2.97 and g-perp. = 1.41. In crystals containing isotopically enriched oxygen, the hyperfine interaction with the O17 nucleus was measured. A qualitative comparison of the ESR parameters of O2(-) in NaF with the determinations of the electronic structure of O2(-) in other alkali halides is made. The large G-shifts and the appreciable perturbation of the O2(-) molecular orbitals in the small NaF lattice make a quantitative treatment difficult. Optical studies of O2(-) in NaF were made. No absorption band in the near ultraviolet, nor fluorescence excited in that region, could be detected. An absorption at 8.7 ev was assigned to a charge-transfer band of O2(-). Several other paramagnetic defects, probably associated with oxygen, were also formed in the course of the x-ray production of O2(-). Their spin resonance patterns were studied but no identification was made. Author (TAB)

N68-13366# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
QUANTUM MECHANICAL CALCULATION OF FORCE CONSTANTS OF MOLECULES AND COMPRESSIBILITIES OF CRYSTALS
Emmett B. Moore, Jr. and Charles M. Carlson Jul. 1967 25 p refs
(D1-82-0649; AD-661395)

The successful use of extended Huckel theory (EHT) in calculating the energies of vacancy migration and Frenkel pair formation in graphite and the observation that the value of the EHT energy is a minimum for the equilibrium structure have prompted an examination of the use of EHT in calculating the elastic properties of crystals. Because EHT wave functions are calculated more rigorously than EHT energies, and are therefore better approximations to self-consistent-field wave functions, two sets of calculations were carried out, one based on EHT energies and the other based on EHT wave functions. The force constants of a number of homonuclear diatomic molecules were also carried out as a check on the procedures used. TAB

N68-13368* General Electric Co., Pleasanton, Calif. Nuclear Technology Dept.
IRRADIATION OF HIGH PURITY ALUMINA Topical Report
T. L. Gregory 5 Jun. 1967 79 p refs
(Contract NAS3-2544)
(NASA-CR-72334; GEST-2101) CFSTI: $3.00 CSCL 20L

In-situ measurements of electrical resistivity and voltage breakdown were performed on cylindrical specimens of high purity alumina. Eight specimens were irradiated for 1290 hours at temperatures of 800 to 1000°C and received a fast neutron (>1 MeV) dose of 1.4 to 1.6×10^{20} nvt. Data of the pre-irradiation and in-situ electrical measurements are reported and analyzed; the results of the post-irradiation examination of the specimens are presented. Author

N68-13431# Arizona State Univ., Tempe.
ELECTRICAL PROPERTIES OF RARE EARTH OXIDES Final Report, 1 Apr. 1965–30 Sep. 1967
Clement J. Kevane 30 Sep. 1967 5 p refs
(Grant AF-AFOSR-609-65)
(AFOSR-67-2649; AD-661584)

A summary is given of a program of research intended to elucidate the mechanism of electrical conduction in rare earth oxides and to clarify the defect structure of these and other oxides. TAB

N68-13449# California Univ., Los Angeles. Dept. of Physics.
SPECTROSCOPY OF CRYSTALS AND OTHER TOPICS IN SOLID STATE PHYSICS Annual Report, Oct. 1, 1966–Sep. 30, 1967
Raymond L. Orbach and Philip Pincus 30 Sep. 1967 27 p refs
(Contract Nonr-233(88))
(AD-661330)

Brief summaries are given of 26 papers which have been published or submitted for publication. The range of topics includes the following: Spin-lattice interactions in magnetic insulators; Exchange interactions between nearest-neighbor ion pairs; EPR hyperfine interactions; Paramagnetic resonance spectra of rare-earth impurities in crystals; Surface states in superconductors; Transport properties of paramagnetic salts. TAB

N68-13465# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
OPTICAL AND INFRARED SPECTROSCOPY
C. H. Perry *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 25–35 refs (See N68-13461 04-23)

Reflection spectra of CdS_xSe_{1-x} for the concentration range $0.07<x<0.71$ were extracted from quantized interferograms by taking a discrete phase-corrected Fourier transform of the data. Raman spectra were measured at 300°K and 80°K, and transmission spectra were measured at 300°K, 80°K, and 10°K. The present investigation reveals the behavior of the triple degenerate optic-mode frequency shift of both, long-wavelength longitudinal optic, and transverse optic phonons as functions of x. G.G.

N68-13467# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MAGNETIC RESONANCE
J. S. Waugh, R. A. Hoffman, R. E. J. Sears, and I. Zupancic *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 45–46 (See N68-13461 04-23)

Repeated application of a cycle of three equally spaced NMR pulses is proposed in order to reduce the static magnetic dipole–dipole interactions in a solid without limits. The first and third of these are 90° radio frequency pulses differing in carrier phase by 90°, and the second lasts twice as long and has its phase switched by 90° at the center. When the period of this cycle of pulses becomes smaller compared with the natural transverse relaxation time of the spin system, then the system behaves as though it were subjected to a time-independent Hamiltonian. The total effective Hamiltonian thus becomes the ordinary Hamiltonian for scalar coupling and scaled down chemical shifts. Preceding magnetization resulting from the application of the pulse train is oscillatory and its Fourier transform is identical to the steady-state unsaturated slow passage NMR spectrum. G.G.

N68-13622*# General Dynamics/Electronics, Rochester, N. Y. Research and Advanced Technology Dept.
STUDY OF SOLID LASER MATERIALS Final Report
F. C. Unterleitner and H. Banerjee Jun. 1967 44 p refs
(Contract NAS12-120)
(NASA-CR-86020) CFSTI: HC $3.00/MF $0.65 CSCL 20L

An attempt was made to find a set of crystal field parameters which would permit calculation of eigenfunctions and eigenvalues for $4F^n$ electron configurations of rare earth ions in yttrium aluminum garnet, particularly those below 14,000 cm^{-1}. A scanning spectrometer for recording the absorption spectra of optically pumped materials was developed. The metastable state absorption spectrum of Nd^{3+}:YAG was measured between 10,000 cm^{-1} and 30,000 cm^{-1}. A few sharp absorption lines were observed which correspond to transitions to states also observed in the ground state absorption. Removal of pump lamp energy at wavelengths shorter than 5000 Å for continuous wave Nd^{3+}:YAG lasers is recommended on the basis of this continuum metastable state absorption. Author

N68-13682# Naval Research Lab., Washington, D. C.
SURVEY OF LUMINESCENCE DOSIMETRY
James H. Schulman *In its* Luminescence Dosimetry Apr. 1967 p 3–33 refs (See N68-13681 04-14)

The effects of high-energy radiation on the optical properties of solids are reviewed, with particular attention given to radiation induced photoluminescence and thermoluminescence. The design and performance of selected devices embodying these materials are described. Author (NSA)

N68-13684# Wisconsin Univ., Madison. Dept. of Physics.
THERMOLUMINESCENCE VS. ROENTGENS IN LITHIUM FLUORIDE: A PROPOSED MATHEMATICAL MODEL
J. R. Cameron, D. W. Zimmerman, and R. W. Bland *In* NRL Luminescence Dosimetry Apr. 1967 p 47–56 refs (See N68-13681 04-14)

The integrated thermoluminescence (TL) as a function of the exposure in roentgens (R) was measured for several sources of LiF. All TL vs. R curves show the following properties: for sufficiently low values of R, TL/R is a constant; at higher values of R, TL/R increases linearly with R with the same shape glow curve; and at large values of R, TL/R approaches a constant even though the shape of the glow curve may be changing. A simple model is proposed that assumes an initial number of unfilled traps N_O, the creation of traps by irradiation with a proportionality constant α, the filling of traps by irradiation with a proportionality constant β, and a maximum number of traps N_F. If N is the number of traps (filled and unfilled) at any R and L is the number of filled traps at any R, then $(dN/dR) = \alpha(N_F-N)$ and $dL/dR = \beta(N-L)$. It was possible to fit this equation to the experimental data for the several sources of LiF and thus to evaluate the four parameters N_O, N_F, α, and β for each. These values for TLD-100 are presented. Author (NSA)

N68-13685# Giessen Univ. (West Germany).
A SIMPLE MODEL FOR THERMOLUMINESCENCE AND THERMALLY STIMULATED CONDUCTIVITY OF INORGANIC PHOTOCONDUCTING PHOSPHORS AND EXPERIMENTS PERTAINING TO INFRARED-STIMULATED LUMINESCENCE
P. Braeunlich, D. Schaefer, and A. Scharmann *In* NRL Luminescence Dosimetry Apr. 1967 p 57–73 refs (See N68-13681 04-14)

Approximate solutions of the well-known balance equations for the kinetic electron processes of thermoluminescence and thermally stimulated conductivity are discussed for the cases where retrapping of electrons and holes is small, where retrapping of electrons and holes is large, where retrapping of electrons is large and that of holes is small, and where retrapping of electrons is small and that of holes is large. The formulas for thermoluminescence by Randall and Wilkins and by Garlick and Gibson are derived as special cases by certain simplifications. Experiments concerning infrared-stimulated luminescence and its application to dosimetry are described. Author (NSA)

N68-13686# Naval Research Lab., Washington, D. C.
THERMOLUMINESCENCE AND COLOR CENTERS IN LITHIUM FLUORIDE
Esther W. Claffy *In its* Luminescence Dosimetry Apr. 1967 p 74–85 refs (See N68-13681 04-14)
(Contract AT(49-7)-1864)

Magnesium impurity in irradiated LiF produces, at room temperature, color centers with absorption bands at 3100, 3400, and 3800 Å. The 210°C thermoluminescence glow peak in irradiated LiF is related to the presence of magnesium and to the color centers producing the 3400 Å absorption band. The 285°C glow peak, also related to the presence of magnesium, is correlated with the 3100 Å absorption. The relative proportions of the 3100 and 3800 Å absorption bands vary with the thermal history of the crystal from 3100 Å (aggregated magnesium) to predominantly 3800 Å (dispersed magnesium). The 3400 Å band is usually not directly observable because of band overlap. The bands at 3100, 3400, and 3800 Å bleach upon irradiation into the F band with 2537 Å ultraviolet light and are attributed to hole type defect centers. Author (NSA)

N68-13687# Wisconsin Univ., Madison. Dept. of Physics.
THERMAL ANNEALING EFFECTS ON THE THERMOLUMINESCENCE OF LITHIUM FLUORIDE
D. W. Zimmerman, C. R. Rhyner, and J. R. Cameron *In* NRL Luminescence Dosimetry Apr. 1967 p 86–100 refs (See N68-13681 04-14)

Isothermal annealing before or after irradiation is found to have a definite effect upon the thermoluminescent glow curve of LiF (TLD-100). Postirradiation annealing, by thermally releasing electrons from their traps, reduces the size of each peak in the glow curve. The two main dosimetry peaks each have a simple exponential decay consistent with the model of Randall and Wilkins, indicating trap depths of 1.2 and 1.25 eV, respectively, with frequency factors between 10^{11} and 10^{12} sec^{-1}. Preirradiation annealing at 80°C for 24 hr reduces the area of the low-temperature peaks by a factor of 10; annealing at 125°, 145°, or 175°C for 3 hr reduces the area of the main dosimetry peaks by a factor of 2 to 5 and increases the height of one of the low-temperature peaks by a factor of 1-1/2 to 3. The rate of cooling from temperatures greater than about 150°C affects the glow curve also. Rapid cooling in times of the order of seconds increases the heights of the low-temperature peaks up to a factor of 4 compared to cooling in several minutes or more. Author

N68-13688# California Univ., Livermore. Lawrence Radiation Lab.
REPRODUCIBILITY STUDIES OF THE PREPARATION OF A LITHIUM FLUORIDE DOSIMETRIC MATERIAL
D. E. Jones and A. K. Burt *In* NRL Luminescence Dosimetry Apr. 1967 p 103–112 refs (See N68-13681 04-14)

The investigation includes (1) a study of the effects of the gas atmosphere during the melting phase of preparation; (2) the preparation of similar phosphor material by coprecipitation of LiF with impurities from solution; (3) a study of samples that have been heat-treated and/or diffusion-doped at varying temperatures below the melting point, including precipitated samples; (4) a study of inhomogeneous samples that have been separated according to the color of fluorescence under ultraviolet excitation; and (5) a study of new samples prepared by the original technique of adding impurity solutions to finely ground LiF crystals and drying before fusing the sample. The results are discussed and some general conclusions are drawn. Author

N68-13689# Naval Research Lab., Washington, D. C.
USE OF LITHIUM BORATE FOR THERMOLUMINESCENCE DOSIMETRY
J. H. Schulman, R. D. Kirk, and E. J. West *In its* Luminescence Dosimetry Apr. 1967 p 113–117 refs (See N68-13681 04-14)

Manganese-activated lithium borate, $Li_2B_4O_7$ (0.1 wt. % Mn), may be of value for thermoluminescence dosimetry. A low-temperature glow peak at 55°C decays rapidly on storage, but a stable glow peak at 200°C is useful for dosimetry. Thermoluminescence output (measured by the height of the 200°C peak) is linear with dose to about 150 R, above which it is supralinear. Saturation begins at about 3×10^5 R. The thermoluminescence output per roentgen for lithium borate is about one-tenth that for LiF (TLD-100); thus the minimum detectable γ-ray exposure is about ten times higher than that obtainable with LiF. The calculated energy dependence of the output per roentgen is low, being comparable to and somewhat smaller than the energy dependence of LiF. Author (NSA)

N68-13690# Naval Research Lab., Washington, D. C.
TERBIUM-ACTIVATED THERMOLUMINESCENT GLASS FOR DOSIMETRY
R. J. Ginther *In its* Luminescence Dosimetry Apr. 1967 p 118–131 refs (See N68-13681 04-14)
(Contract AT(49-7)-1864)

A newly developed terbium-activated lithium aluminosilicate glass is shown to have promise as a thermoluminescent dosimeter. Its sensitivity, energy dependence, spectral distribution of emission, glow-curve characteristics, and storage stability are all favorable for dosimetric purposes. One disadvantage is the supralinear response of the material for γ-ray exposures greater than about 10 R. The advantage of the use of clear glass plates rather than powders is illustrated. Optical studies of the material have shown that the energy traps in the glass are closely associated with the terbium ions. Author (NSA)

N68-13691# Polytechnic Inst. of Brooklyn, N. Y.
ORGANIC PHOSPHORESCENT MATERIALS
Gerald Oster and Gavriella Gabor *In* NRL Luminescence Dosimetry Apr. 1967 p 132–137 refs (See N68-13681 04-14)
(Contracts AT(30-1)-2206; Nonr-839(36))

Irradiation by X-rays or by ultraviolet light produces an enhanced phosphorescence in plastics containing dibenzanthracene. Samples that have been irradiated exhibit a thermoluminescence when heated above room temperature. The phosphorescence enhancement is accompanied by an increase of the absorption at

450 mμ and by a free-radical electron-spin-resonance signal. When the irradiated material is allowed to stand for long periods of time at room temperature, all these characteristics decay.
Author (NSA)

N68-13692# Manufacture Belge de Lamps et de Material Electronique, Brussels (Belgium).
THERMOLUMINESCENT PROPERTIES OF NATURAL CALCIUM FLUORIDE
R. Schayes, C. Brooke, I. Kozlowitz, and M. Lheureux *In* NRL Luminescence Dosimetry Apr. 1967 p 138–157 (See N68-13681 04-14)

A review of important thermoluminescent (TL) properties of natural CaF_2 is made. Most samples show the same fundamental TL peaks but with variable relative and absolute amplitudes. The most often encountered peaks are peaks I and I′ below 100°C, peak II at 150°C, peaks III and III′ at 275 and 300°C, peak IV at 350°C, and peaks V and VI above 500°C. The absolute efficiency expressed as the energy spent by ionizing particles to create one photoelectron (for perfect optical coupling) is determined for the various phosphors (LiF, CaF_2:Mn, and natural CaF_2). Measurements were made on variable-thickness phosphors, and the influence of grain size was estimated. The most efficient phosphors were found to be our specially selected and processed natural CaF_2. The effects of high-temperature annealing and very high γ dose are clarified. High-temperature exposure induces a permanent decrease of sensitivity above 600°C without changing appreciably the scintillation properties. Increase of sensitivity under high γ dose exists also, but it is complicated by the dependence on both prior and subsequent (to γ irradiation) heat treatments. Some photoeffects on sensitivity are also noticed. Linearity as a function of the γ-ray exposure extends to the kiloroentgen range, where saturation occurs variably for the different peaks. Superlinearity is also sometimes observed. The light-induced or -modified thermoluminescence is examined in some detail. The three main components of these light effects are separated as a purely light-excited TL, a light-deexcitation effect on filled traps, and the transfer phenomena induced by light irradiation on previously γ-irradiated and erased samples or dosimeters. This last process leads to the possibility of a memory effect. It is shown to be connected with a light-emptying process acting on very-high-temperature traps (peaks V and VI) and a transferring of charge carriers to lower temperature traps, which can be erased by the usual TL measurement (peak III′ mainly).
Author (NSA)

N68-13693# Kansas Univ., Lawrence.
THERMOLUMINESCENCE OF SOME CARBONATES, THORIUM DIOXIDE, AND BARIUM TITANATE
Ernest E. Angino *In* NRL Luminescence Dosimetry Apr. 1967 p 158–166 refs (See N68-13681 04-14)

Analytical-reagent-grade material (powdered) of magnesium, calcium, strontium, and barium carbonates was first heated to 400°C for 1 hr to remove any thermoluminescence that might have been present and subsequently was subjected to γ-ray exposures of 235×10^3 R or 470×10^3 R. All the analytical-reagent-grade samples checked showed considerable thermoluminescence, with $SrCO_3$ several times more sensitive to radiation than the others. Replicate runs on $MgCO_3$ after irradiation with 470×10^3 R showed good reproducibility to peak temperatures and intensities. Preliminary results definitely suggest that the structure of the carbonates may well have considerable effect on the thermoluminescence observed in the different materials. A large symmetrical glow peak was found in unirradiated thoria (ThO_2) at 195±5°C. After irradiation with 10^4 to 10^6 R of ^{60}Co γ-rays a smaller peak appeared at 65±5°C. The thermoluminescence characteristics of these compounds and, in addition, $BaTiO_3$ suggest that consideration be given to these materials for use as dosimeters.
Author

N68-13694# Naval Research Lab., Washington, D. C.
EMISSION SPECTRA OF VARIOUS THERMOLUMINESCENT MATERIALS
S. G. Gorbics *In its* Luminescence Dosimetry Apr. 1967 p 167–182 refs (See N68-13681 04-14)
(Contract AT(49-7)-1864)

The thermoluminescence emission spectra of various materials have been determined with the use of a quartz-prism spectrograph. The materials studied include CaF_2:Mn, $CaSO_4$:Mn, $Li_2B_4O_7$:Mn, LiF(TLD-100), CaF_2(MBLE), and a terbium-activated lithium aluminosilicate thermoluminescent glass. The spectra was measured photographically and corrected by means of a National Bureau of Standards quartz-iodine tungsten-filament standard of spectral irradiance. Precautions were taken to prevent spectral distortions resulting from the variation in sensitivity of the film as a function of wavelength and from reciprocity-law failure. The radioluminescence spectrum of several of these materials was also determined and compared to the thermoluminescence spectrum.
Author

N68-13695# California Univ., Livermore. Lawrence Radiation Lab.
SULFIDES OF STRONTIUM, CALCIUM, AND MAGNESIUM IN INFRARED-STIMULATED LUMINESCENCE DOSIMETRY
E. N. Sanborn and E. L. Beard *In* NRL Luminescence Dosimetry Apr. 1967 p 183–191 refs (See N68-13681 04-14)
(Contract W-7405-ENG-48)

The results obtained and the problems encountered during a study of certain sulfide types of stimulated-luminescence dosimeter materials are discussed. These materials were prepared by doping the sulfate of strontium, calcium, or magnesium with europium and samarium ions and then reducing it to the corresponding sulfide. All three dosimeters have about the same sensitivity to γ radiation from ^{60}Co. However, the spectrum of their infrared-stimulated light flash varies. Decay curves of the light flash vs. time show that the magnesium sulfide dosimeter is most readily discharged by infrared stimulation. However, the thermoluminescent peaks of the three dosimeters occurred at about the same temperature. The magnesium sulfide dosimeter has several properties in its favor, but there are problems in designing a satisfactory package for it.
Author

N68-13696#
USE OF MANGANESE-ACTIVATED AND SAMARIUM-ACTIVATED CALCIUM SULFATE IN THERMOLUMINESCENCE DOSIMETRY
Bengt Bjaerngard *In* NRL Luminescence Dosimetry Apr. 1967 p 195–203 refs (See N68-13681 04-11)

The possibility of employing $CaSO_4$:Mn to measure small γ-ray exposures, taking advantage of the high light yield and the relative absence of serious background problems, was investigated. With the system described, exposures down to 50 μR of 1-MeV γ radiation can be measured. This $CaSO_4$:Mn dosimetry technique has been used for mapping the dose distributions that result when activity is released in air or water. Experience shows that this method is simple reliable, and useful for such studies. In contrast with the $CaSO_4$:Mn, the most important quality of $CaSO_4$:Sm is the high temperature of the main glow peak. The resulting high stability of the light sum may be utilized for γ-ray dose measurements at elevated temperatures, for which the number of reliable dosimeter types is small. Results from an investigation of the properties of $CaSO_4$:Sm thermoluminescence deviate from those reported previously in some important respects. For instance, the main glow peak lies at a higher temperature, at about 400°C. The light yield is of the same order of magnitude as that of $CaSO_4$:Mn. The signal increases in a superlinear way with the γ-ray exposure or dose. The parameters of this response function have been determined, and the superlinearity is interpreted as caused by the generation of new traps during the irradiation. The fading

of the light sum in $CaSO_4$:Sm was investigated under various circumstances. It is concluded that the signal in the 400°C glow peak is stable up to 200°C. If corrections are made for the influence of the temperature on the sensitivity during the irradiation, it is possible to use $CaSO_4$:Sm at 300°C with exposure times that do not exceed some hours. The system presently used does not permit measurements of exposures less than 1 R. Particularly, the emission of incandescent light is a serious background component because of the high temperature needed for the readout procedure. NSA

N68-13699# Hammersmith Hospital, London (England).
SPURIOUS THERMOLUMINESCENCE AND TRIBOTHERMOLUMINESCENCE IN LITHIUM FLUORIDE DOSIMETRY POWDER
Vesna Svarcer and J. F. Fowler *In* NRL Luminescence Dosimetry Apr. 1967 p 227–235 refs (See N68-13681 04-14)

Investigations are described of the nature of the spurious signal appearing at a higher temperature than the dose peak in LiF. Nitrogen removes it. In air or oxygen it can only be produced at full magnitude by movement of the powder. A small proportion of the effect appears, however, if the powder is left undisturbed in the reader tray for many hours. If the powder is stirred with earthed or insulating rods, the effect is greater with the insulating rods. Cementing powder to metal removes the effect. The use of single crystals of LiF also eliminates the effect. These results suggest that the spurious signal is due to surface-trapping states. Adsorbed gases and movement of the powder both would be expected to affect the surface states of the crystals. Author (NSA)

N68-13700# Oxford Univ. (England).
QUENCHING OF SPURIOUS THERMOLUMINESCENCE BY NITROGEN
M. J. Aitken, J. Reid, M. S. Tite, and S. J. Fleming *In* NRL Luminescence Dosimetry Apr. 1967 p 236–243 refs (See N68-13681 04-14)

The natural thermoluminescence from ancient ceramics is drastically reduced if the glow curve is taken in an atmosphere of nitrogen instead of air. Whereas the true radioluminescence is unaltered, the glow resulting from other sources (e.g., grinding and chemical change) is largely eliminated. Oxygen-free (less than 10 ppM) nitrogen is necessary to achieve this in some cases. Similar effects are observed with limestone and LiF. For a sample of limestone, the spurious glow in air can be resolved into two peaks, at 420° and 530°C. The different responses to mechanical disturbance and to thermal treatment suggest that the lower peak is triboluminescence but that the higher one is associated with chemical change. Mineralogical separation studies show the lower peak to be carried by quartz impurities and the higher one by microcrystalline calcite. Larger grains of calcite carry piezoluminescence, which is partially quenched in nitrogen. Spurious glow can also be reduced by using carbon dioxide or by painting the glow plate with a reducing agent. Combining the painting with the carbon dioxide (or with nitrogen) reduces the spurious glow from the lithium fluoride by a factor of more than 1000. It is suggested that the removal of spurious glow arises from the absence of oxygen rather than from any specific quenching action. Author (NSA)

N68-13701# Naval Research Lab., Washington, D. C.
SPURIOUS THERMOLUMINESCENCE OF CaF_2:Mn AND LiF(TLD-100)
A. E. Nash, Frank H. Attix, and J. H. Schulman *In its* Luminescence Dosimetry Apr. 1967 p 244–256 refs (See N68-13681 04-14) (Contract AT(49-7)-1864)

Thermoluminescent materials can generally be excited to thermoluminescence not only by ionizing radiations but by certain other stimuli as well. One of these is friction, giving rise to tribothermoluminescent (TTL) light emission. The TTL glow-peak temperature, intensity, and spectral distribution are all influenced by the ambient gas present during the heating and the light emission. The γ-ray-induced thermoluminescence is not influenced in these ways. The surface and volume effects thus seem to be independent of one another. Author (NSA)

N68-13702# Pennsylvania State Univ., University Park. Materials Research Lab.
FIELD-EFFECT ENHANCEMENT OF THERMOLUMINESCENCE
K. Miyashita and H. K. Henisch *In* NRL Luminescence Dosimetry Apr. 1967 p 259–264 refs (See N68-13681 04-14)

Experiments are described in which average fields of the order of 10^5 V/cm applied to powder phosphors produce an enhancement of thermoluminescence by factors of 100 and more. The enhancement arises in all likelihood from the acceleration of thermally released electrons and subsequent impact ionization. The constancy of the enhancement factors enables the effect to be used for dosimetric purposes. Author (NSA)

N68-13708# Kyoto Univ. (Japan). Research Reactor Inst.
THERMOLUMINESCENCE DOSIMETRY OF GAMMA RAYS FROM ATOMIC BOMBS IN HIROSHIMA AND NAGASAKI
Takenobu Higashimura, Yoneta Ichikawa (Nara Gakugei Univ.), and Tunahiko Shidei *In* NRL Luminescence Dosimetry Apr. 1967 p 325–330 refs (See N68-13681 04-14)

Thermoluminescence-dosimetry techniques were applied to roof tiles to obtain the γ-ray exposure from atomic bombs dropped on Hiroshima and Nagasaki 20 years earlier. Thermoluminescence intensities were measured and compared with those induced by known irradiations of ^{60}Co γ-rays. Equivalent γ-ray exposures thus obtained were corrected for the effects of slow neutrons, self-shielding, and the energy dependence of the dosimeter γ-ray response per roentgen to obtain the corrected exposures. The distributions of γ-ray exposure vs. distance from the hypocenter were compared with those of York. There was close agreement for the Nagasaki data, but results for Hiroshima were lower than York's data by about 40%. Author

N68-13719# Naval Radiological Defense Lab., San Francisco, Calif.
RESPONSE OF LITHIUM FLUORIDE TO NEUTRONS AND CHARGED PARTICLES
Catharine L. Wingate, Eugene Tochilin, and Norman Goldstein *In* NRL Luminescence Dosimetry Apr. 1967 p 421–434 refs (See N68-13681 04-14)

The thermoluminescent response of LiF was investigated with thermal and fast neutrons at energies extending from 0.26 to 14 MeV. The results indicated that thermal neutron fluence may be conveniently measured with normal LiF but that a higher readout temperature is required than for gamma dose measurements. Studies of fast neutron response with ^7LiF (to minimize thermal effects) showed a low neutron sensitivity that was strongly dependent on energy. Fast neutron response was also investigated for a dosimeter in which the powder was suspended in alcohol. The linear-energy-transfer response of LiF was studied using α particles with energies from 900 down to 2 MeV. Author

N68-13725# Oxford Univ. (England).
THERMOLUMINESCENT RESPONSE TO HEAVILY IONIZING RADIATIONS
M. J. Aitken, M. S. Tite, and S. J. Fleming *In* NRL Luminescence Dosimetry 2 Apr. 1967 p 490–501 refs (See N68-13681 04-14)

Glow-curve measurements were made on various substances (ancient ceramics, limestone, aluminium oxide, bentonite, LiF, and CaF_2) after irradiation with α and β particles, 10-MeV protons, 30-MeV ^3He ions, and 50-keV X-rays. For ceramics and limestone the results from long irradiations, with successively increasing doses, indicate that significant trap creation may occur with X-rays but that the interaction of α particles with the lattice manifests itself predominantly as damage to the thermoluminescent response rather than as an enhancement of it. For low dose levels such effects are small compared to the thermoluminescence arising from the trapping of electrons in existing defects. Indirect evidence about the relative effects of different types of radiation can be obtained from age-determination measurements on archaeological pottery fragments of known date of firing (i.e., thermal drainage) by ancient man. Such measurements are consistent with a thermoluminescent response for α particles that is lower than for β particles by a factor of about 10. This has been confirmed by direct measurements in a number of cases. For LiF the lower sensitivity to α particles is interpreted in terms of localized regions of saturation along the particle tracks. Author (NSA)

N68-13754# Iowa State Univ. of Science and Technology, Ames.
ON THE ELECTRICAL RESISTIVITY AND THE BETA TO ALPHA TRANSFORMATION OF LANTHANUM
John Edward Omohundro (M.S. Thesis) Aug. 1967 76 p refs
(Contract W-7405-ENG-82)
(IS-T-192) CFSTI: HC $3.00 / MF $0.65

The temperature dependence of the electrical resistivity of La metal has been determined for the temperature range from 85°K to 975°K. A resistive hysteresis in the temperature range of 200°C to 300°C has been observed and has been associated with an allotropic transformation. Time based isothermal studies of the electrical resistance of La specimens quenched from 350°C have been made which indicate that the transformation occurs in two stages. Activation energies are 380 cal/gram-atom for the first stage but could not be determined for the second stage from the data obtained in this work. The transition between stages has been associated with the depletion of sites for the ready formation of nuclei. Transmission electron microscopy has been employed to examine the microstructure and the thermal behavior of La over the temperature range of −150°C to 320°C, and the continuation of the transformation to the α or low temperature form has been observed to be suppressed to as far as −150°C in thin foils. Apparent discrepancies in this work and conflicts with work reported in the literature have been qualitatively explained, in part, based on a point defect elimination mechanism. Author (NSA)

N68-13810# Massachusetts Inst. of Tech., Cambridge.
SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report
15 Oct. 1967 98 p ref
(Contract Nonr-1841(34); Grants NSF G-24908; NSF GP-3241)
(QPR-66; AD-661809)

Contents: Energy bands of the alkali metals: II. Rubidium and cesium; Double space group representations for the diamond and white tin structures; The effects of screened exchange and correlation on the surface potential of an electron gas; Darwin again; Stellar maser. TAB

N68-13868# Uppsala Univ. (Sweden). Inst. of Physics.
CALCULATION OF THE ELASTIC CONSTANTS OF NAF. 2: EFFECT OF SCALING
G. Pettersson, J. Vallin, J.-L. Calais, and K. Mansikka Apr. 1967 19 p refs
(UUIP-537)

The cohesive energy, the lattice distance, the compressibility, and the elastic constants of NaF were calculated by Loewdin's quantum mechanical method. The effect from the crystal field on the relatively loosely bound 2p electrons of the F^- ion was taken into account by radial scaling of their orbitals. In determining the repulsive energy, interactions between nearest neighbors as well as next nearest (negative) neighbors were calculated. Author (NSA)

N68-13899# Cornell Univ., Itahca, N. Y. Materials Science Center.
ELECTRON SPIN RESONANCE AND OPTICAL STUDIES OF HYDROXIDE-DOPED SODIUM FLUORIDE; THE EFFECTS OF IMPURITIES ON COLOR CENTER FORMATION
Marvin Lawrence Meistrich (Ph.D. Thesis) Sep. 1967 133 p refs Sponsored in part by ARPA
(Contract Nonr-401(54))
(Rept.-758; TR-6; AD-661340)

Results are reported of a study of anionic (OH(-), O2(-), H(-), and O(--)) color center formation and reactions in sodium fluoride, and of the identification of chemical states of impurities and observation of the alteration on these states. TAB

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-12984# Brigham Young Univ., Provo, Utah. Chemical Engineering Dept.
EXTINCTION OF BURNING SOLID PROPELLANT Final Report, Mar. 1965–Feb. 1967
M. Duane Horton 25 May 1967 35 p refs
(Grant AF-AFOSR-897-65)
(AFOSR-67-1767; AD-661971)

The paper presents the results of a combined theoretical and experimental study of the process in which solid propellant combustion is terminated by a rapid drop in pressure. Experimentally, propellant burning in a small rocket motor was subjected to a rapid pressure drop when an auxiliary nozzle was suddenly opened. Such tests were run with varying nozzle sizes for the auxiliary nozzle and the boundary between extinction and non-extinction was determined. The results were then compared to the predictions of the theoretical model which was based on the assumption that extinction occurs when the heat absorption by the solid propellant surface exceeds the heat transfer to the solid propellant surface from the combustion gas. In general, the theoretical predictions agreed well with both the experimental results gathered in the program and those published by other investigators. Author (TAB)

N68-13031*# Stanford Research Inst., Menlo Park, Calif.
THE STORABILITY AND THERMAL STABILITY OF SOLUTIONS OF 10 TO 30% AMMONIUM PERCHLORATE IN HYDRAZINE

C. H. Martin and R. F. Muraca 15 Aug. 1967 23 p Prepared for JPL
(Contracts NAS7-100; JPL-951581)
(NASA-CR-91438; SRI-951581-5) CFSTI: HC $3.00/MF $0.65 CSCL 21I

The storability of solutions of 10 to 30% (W/W) of ammonium perchlorate in hydrazine was established by determining that their ullage pressures at temperatures from 50° to 75°C (122° to 167°F) remained constant for over 7 months; the freezing points of these solutions ranged from about −5° to −25°C (23° to −13°F). The thermal stability at higher temperatures was determined by JANAF Method No. 6; with this equipment, it was possible to determine that solutions of 10 to 30% ammonium perchlorate may be stored at temperatures in the vicinity of 80°C (176°F) for as long as 18 hours without rupture of 1800-psig diaphragms, but detonation occurred within one hour at about 100°C. The solutions detonated at about 160°C (320°F) when heated at rates in excess of 10°C per minute; at similar heating rates, hydrazine did not detonate, but it rapidly generated pressure at 220°C (428°F) and ruptured 1800-psig burst-diaphragms in the JANAF apparatus. Author

N68-13227# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE THERMAL STABILITY OF HYDROCARBON FUELS [O TERMICHESKOY STABIL'NOSTI UGLEVODORODNYKH TOPLIV]
M. B. Vol'f, B. L. Kozik, and G. P. Morozova 5 Sep. 1967 19 p refs Transl. into ENGLISH from Tr. UFA Bashkirsk. Nauchn. Issled. Inst. po Pererabotke Nefti. (USSR), no. 003, 1960 p 51–61
(FTD-MT-65-320; AD-661441)

The thermal stability of fuels for air-breathing jet engines was investigated in a glass placed in a bomb for determining the induction period of gasolines. The tests were made in the presence of a copper plate at 100, 150, 200, and 250C in an atmosphere rarefied with atmospheric nitrogen. In specimens of petroleum types poor in sulfur, maximum precipitation was observed at 200C and in fuels from high-sulfur petroleum types, at 150C. A reduction in the content of aromatic hydrocarbons (especially bicyclic ones) increases the thermal stability of fuels. When the content of paraffins is decreased and that of naphthenes increased, precipitation increases. An increase of the oxygen concentration in the oxidation atmosphere intensifies precipitation. At 150-200C, certain antioxidants reduce the formation of precipitates in fuels. TAB

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-12849*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A 15-CENTIMETER DIAMETER, HOLLOW-CATHODE KAUFMAN THRUSTOR
R. T. Bechtel, G. A. Csiky, and D. C. Byers Washington 1968 25 p refs Presented at the 6th Aerospace Sci. Meeting, New York, 22–24 Jan. 1968 Sponsored by AIAA
(NASA-TM-X-52376) CFSTI: HC $3.00/MF $0.65 CSCL 21C

A mercury bombardment 15-centimeter diameter, permanent magnet Kaufman thrustor is planned for the SERT II mission. The original thrustor design used a thermionic, oxide magazine cathode, but the advantages of a hollow cathode prompted its substitution. The changes in the thrustor were a redesign of the magnetic field shaping pole pieces and the propellant feed system. Additions to the thrustor were a baffle and a keeper electrode. Baffles of several designs were located on the thrustor axis downstream from the cathode. These baffles were found to significantly effect the propellant utilization efficiency and discharge chamber losses. The keeper electrode aided in starting and maintaining a stable cathode discharge. The effect of the magnitude of the neutral propellant flow through the hollow cathode was also investigated. The final thruster configuration has been endurance tested for over 2000 hours at discharge losses of 250 ev/ion and a propellant utilization efficiency of 85 percent. The beam current was 0.25 ampere at a net accelerating voltage of ±3000 volts. Author

N68-12888# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TEST OF AVIATION ENGINES
B. Ye. Brusyanov 4 May 1967 187 p Transl. into ENGLISH of the book "Ispytaniye Aviatsionnykh Dvigateley" (USSR), Oborongiz NKAP, p 1–147
(FTD-MT-65-435; TT-67-62511; AD-656565)

The book concerns questions of purpose and views of aircraft engine tests, the organization of testing installations, the organization and principles of action of instruments applied during the tests. A method of carrying out the test and a method of processing obtained during the tests of materials are considered. Also, types of testing stations and certain questions of operating safety, and hygiene techniques are discussed in the book. Many conclusions are simplified to facilitate mastering the material. Chapters not pertaining directly to the tests, concerning, for instance, questions of general motor theory, questions about fuels and oils sometimes included in books on testing, are omitted. TAB

N68-12942# Aerospace Corp., El Segundo, Calif. Applied Mechanics Div.
EFFECT OF DESIGN ON BOOSTER CHARACTERISTICS
Artur Mager Aug. 1967 52 p refs
(Contract AF 04(695)-1001)
(TR-1001(2305)-1; SAMSO-TR-67-40; AD-661961)

A simple and rapid method for assessing the effect of booster design variables on over-all booster characteristics is presented. This method is applicable to all boosters, regardless of whether they are expendable, reusable, rocket-powered or airbreathing. The computations involved are minimal and many results are obtainable in a purely analytical manner. Furthermore, a convenient graphical representation of gross-to-payload and hardware-to-payload mass ratios, as well as the sensitivity of these ratios to design changes, is also obtained. Design procedures are given which (by properly dividing the required velocity increase among the booster stages) minimize, per unit of payload weight, one of the following: gross weight, hardware weight and/or hardware costs per use. In these procedures the structural factors and the specific impulses are permitted to vary with stage size and booster velocity, respectively. Author (TAB)

N68-13023*# Mathematical Applications Group, Inc., White Plains, N. Y.
NONLINEAR COMBUSTION INSTABILITY IN LIQUID-PROPELLANT ROCKET MOTORS
Samuel Z. Burstein and Wallace Chinitz 30 Oct. 1967 41 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951946)
(NASA-CR-91443; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Nonlinear fluid dynamic equations are used for the linearized solution of a rotating transverse wave in a circular chamber. The equations are derived by usual perturbation techniques. Some results are graphically shown via computer generated plots. The evaporation and combustion model that will be coupled to the gas dynamic equations are presented in detail. The theory has the feature that ignition–extinction phenomena can be included. Included is also a short description of alternate procedures to be tested in the hydrodynamic portion of computer program COMB. Author

N68-13060 Royal Aircraft Establishment, Bedford (England). Blind Landing Experimental Unit.
SOME STUDIES INTO IMPROVEMENTS IN AUTOMATIC THROTTLE CONTROL
N. H. Hughes 1967 17 p Presented at the 31st AGARD Flight Mech. Panel Meeting, Gottingen (W. Germany), 13–15 Sep. 1967

The characteristics of automatic throttle control systems are described with particular reference to speed holding, height holding on the glidepath, and throttle activity. The deficiencies of existing systems are examined, and a modified form of control is presented which shows promise of avoiding most of these deficiencies. Author

N68-13063 Nationaal Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
THE INFLUENCE OF FLIGHT SPEED ON THE THRUST CALIBRATION OF A JET ENGINE
J. P. K. Vleghert 1967 22 p refs Presented at the 31st AGARD Flight Mech. Panel Meeting, Gottingen (W. Germany), 13–15 Sep. 1967
(MP-252)

Engine gross thrust is generally obtained from the pressures over the jet nozzle and its flow area, using a calibration factor derived from test bed comparison of weighed and calculated (Pearson) thrust, which is extrapolated for flight conditions. Flight test results show that the static pressure measured in the jet nozzle plane with a nozzle spider is considerably above the value expected from one-dimensional flow and is influenced by flight speed, especially at low nozzle pressure ratio. Assuming an elliptic static pressure distribution over the jet nozzle diameter, the flow and thrust reduction relative to one-dimensional conditions can be calculated. This factor bears close resemblance to the calibration factor obtained on the test bed. As it can be determined in flight, possible discrepancies between test bed and flight conditions will be shown up. A possible source of discrepancies is the absence, in most cases, of secondary flow outside the nozzle under test bed conditions. Author

N68-13099* Northrop Corp., Hawthorne, Calif. Norair Div.
REACTION CONTROL SYSTEM PRELIMINARY DESIGN CONSIDERATIONS FOR A JET-LIFT RESEARCH AIRCRAFT
D. L. Hirsch, W. W. Stark, and W. B. Morris [1967] 23 p refs Sponsored by NASA
CFSTI: $3.00 CSCL 21E

The preliminary design of a jet lift aircraft reaction control system has been completed. The aircraft mission is one of terminal area flight control research; the research will involve variation of flight control parameters in hover and transition. Results of the study are presented describing the vehicle arrangement, the low-speed control power requirements, the reaction control system design philosophy, and the preliminary design details of the reaction control hardware. The aircraft employs a vertical side-by-side compacted arrangement of lift engines and two horizontal lift/cruise engines. An engine compressor bleed air system provides reaction control. Maximum single axis control power levels were established on the basis of summed elements for trim, maneuver, and recovery from a single engine failure. The all-axis simultaneous control power requirement established at 60 percent of the single axis maximums was normally the critical requirement. An engine compressor bleed rate variable up to 10 percent was available to meet all these demands. Important design requirements were: (1) minimum cross-coupling between attitude control and lift forces; (2) near constant control sensitivity; and (3) low system weight. A system employing swiveling and differential discharge area nozzles offered the most satisfactory design solution. Author

N68-13134*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIOISOJET PROGRAM Summary Report
Sep. 1967 169 p refs Work Done Jointly by NASA–AEC
(NASA-TM-X-63018; X-734-67-475) CFSTI: HC $3.00/MF $0.65 CSCL 21F

The results are presented of the Radioisojet (RIJ) program, which successfully demonstrated the feasibility of the RIJ concept. The RIJ design approach was to simulate the thermal storage resistance jet concept, wherein the thruster body temperature is maintained by a heat shield package. Thrust is obtained by passing a propellant (NH_3) over the isotope heated capsule surface in short pulses. A thrust advantage is gained by causing the propellant to decompose as it traverses the fuel capsule surface. The decomposition process is enhanced by constructing the fuel capsule with a suitable catalytic material. Hastelloy-X was used as the outer capsule surface material for this purpose. Additionally, the thruster design incorporated an interchangeability feature which allows the radioisotope fuel capsule to be replaced by an electrically heated capsule. In this manner base-line and system shake-down tests may be performed using the electrically heated RIJ. The heat source for the RIJ comprised approximately 60 thermal watts of highly purified and aged promethium-147. A performance capability of 232 seconds of specific impulse at a nominal gas temperature of 1500°F and at a thrust level of 20 milli-pounds was demonstrated. Author

N68-13152* Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
COMPARATIVE STUDY OF THRUST-VECTOR-CONTROL SYSTEMS FOR LARGE, SOLID-FUELED LAUNCH VEHICLES. VOLUME 3: APPENDIX MATERIAL
G. D. Budris Nov. 1967 62 p refs
(Contract NAS1-7109)
(NASA-CR-66506; DAC-58067, V. 3) CFSTI: $3.00 CSCL 21H

Calculations necessary to determine warm gas thrust vector control (TVC) are presented to show the procedures used to minimize the size of the generator design, the duct sizing, the changes in motor specific impulse due to TVC, and propellant weights for the integral roll control systems. Generalized performance trends of the gas-injected TVC systems are also discussed, in relation to either a submerged or an external valve system. For the TVC guidance and control analysis, a Fortran program was used to compute the deflection angle of the thrust vector required to statically balance the applied disturbance and uncertainty torques and to provide maneuvering capability. In this case, the thrust vector originates at the nozzle throat. Moment sources caused by wind, resulting from various uncertainties, and required for maneuvering are considered, and it is shown how they are combined to define TVC requirements. Program operation is described, and the equations used are derived. M.G.J.

N68-13235*# Avco Corp., Lowell, Mass. Space Systems Div.
FLIGHT PROTOTYPE AMMONIA STORAGE AND FEED SYSTEM Final Report

Jan. 1967 49 p
(Contract NAS5-10128)
(NASA-CR-91278; AVSSD-0100-67-RR) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A flight-prototype ammonia-propellant storage and feed system was developed that will meet necessary ullage and strength requirements when loaded with 56 lb ammonia. The feed system provides a variation of no more than 1% in regulated pressure when either gaseous or liquid ammonia is used. Design and development are detailed for the propellant storage tank, pressure regulation and propellant feed, the flow control assembly, and the mass flow integrator. Fueling procedure and equipment is discussed, as are sizing of the propellant storage tank and problems associated with a titanium tank. A preliminary stress analysis is included for the titanium tank with a stainless steel regulation system plenum chamber. Among other problem areas noted are the availability of satisfactory solenoid valves and materials compatibility with ammonia propellants. M.W.R.

N68-13372*# Chrysler Corp., New Orleans, La. Space Div.
FINAL FLIGHT PERFORMANCE PREDICTION FOR SATURN AS-204 LM PROPULSION SYSTEM S-IB-4-STAGE
G. W. Koser 20 Nov. 1967 36 p refs
(Contract NAS8-4016)
(NASA-CR-91467; TR-P&VE-67-58) CFSTI: HC $3.00/MF $0.65 CSCL 21H

This report, covering prediction of the S-IB-4 propulsion system flight performance, supersedes CCSD Technical Report TR-P&VE-66-29, Revision B, due to the effects of recent changes in propulsion criteria and launch schedule. These changes also required the propulsion performance dispersions reported in TR-P&VE-66-29 to be revised. Analyses of the prediction data indicate that inboard and outboard engine cutoffs will occur approximately 141.31 and 144.31 seconds after first motion, respectively. These times are based on defined LOX and fuel load specific weights and stage propellant fill weights for the revised launch schedule for AS-204 (first quarter of 1968). Author

N68-13391# Naval Ship Research and Development Center, Annapolis, Md.
REFERENCE DESIGN STUDY OF MIST-JET PROPULSION SYSTEMS IN CAPTURED-AIR-BUBBLE SHIPS
Jack Smith and R. M. Fox Nov. 1967 72 p refs
(NSRDC-2496; AD-661801)

A reference design study was made to evaluate the Mist-Jet propulsion system. Performance characteristics of 100-, 500-, and 2500-ton captured-air-bubble surface effect ships with a Mist-Jet, a water-jet, and a propeller propulsion system were examined. Based on cost per ton mile, payload, and fuel use vs speed for various operational ranges, it was concluded the Mist Jet is a superior propulsion system in the 100-ton size for short-range, high-speed operation. The Mist Jet is competitive with the other two systems in larger size ships at longer range. It is recommended the development of the Mist Jet be pursued as it offers additional advantages of no moving parts in contact with the water, the use of state-of-the-art equipment, and low development cost as compared to the water-jet or the supercavitating controllable-pitch propeller systems. Author (TAB)

N68-13484* Southwest Research Inst., San Antonio, Tex.
STUDY OF MINIMUM PRESSURE LOSS IN HIGH VELOCITY DUCT SYSTEMS Quarterly Report
C. P. Gerlach 3 Nov. 1967 35 p refs
(Contract NAS8-21133; SwRI Proj. 02-2119)
(NASA-CR-91525; QR-2) CFSTI: $3.00 CSCL 21H

Progress is reported for theoretical and experimental investigations of ducting and ducting components with the goal of minimizing pressure drop, surge pressures, and vibration levels, to improve gas and liquid flow conditions in space vehicle feed systems. Several convolution geometries for pressure loss were achieved using a variable configuration test model. Two low pressure loss bellows design models were constructed and tested. Experimental data were obtained on bellows vibration and non-steady pressure generation and a model of a low loss bend or elbow design was constructed and tested. It is concluded that careful attention to convolution geometry can yield at least a 50% reduction in pressure loss. Liners when properly designed can decrease pressure loss and reduce flow induced vibrations. Vortex shedding is the flow mechanism responsible for large pressure losses and vibrations in bellows. A bend with changes in cross section can provide substantial pressure loss reductions compared with a bend of constant geometry cross section. E.C.

N68-13549# Societe pour l'Etude et la Realisation d'Engins Balistiques, Courbevoie (France).
RADIO ISOTOPIC STAGE. PROBLEMS OF CONSTRUCTION AND PERFORMANCE [ETAGE RADIO-ISOTOPIQUE. PROBLEMES DE STRUCTURE ET DE PERFORMANCE]
P. Bisiaux [1967] 38 p In FRENCH; ENGLISH summary Presented at ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication
(ELDO-SP-67-18) CFSTI: HC $3.00/MF $0.65

Discusses problems related to the design and use of an isotopic stage, with liquid H_2 as the working fluid and compares its performance with advanced chemical propulsion stages. Concludes that isotopic propulsion would offer substantial gains for transfer of payloads from a low orbit to the 24 hour orbit and also for satellite auxiliary propulsion and for deep space missions. Technical problems specially considered are tank insulation, thermal and hydrostatic behavior of liquid hydrogen during flight. Author (ESRO)

N68-13565*# National Aeronautics and Space Administration, Washington, D. C.
FROM THE HISTORY OF THE LENINGRAD JET PROPULSION STUDY GROUP (LENGIRD)
V. V. Razumov *In its* Hist. of Aviation and Cosmonautics, Vol. 1 Nov. 1967 p 16–31 ref (See N68-13561 04-02)

Personal recollections of the early years (1930's) of the jet propulsion study group are presented, and the group's achievements are highlighted. The work done by the sub-groups is outlined, and the development and design of the first liquid and solid propellant rockets are described in greater detail. N.E.N.

N68-13568*# Holman (John F.) and Co., Inc., Washington, D. C.
HISTORY OF AVIATION AND COSMONAUTICS, VOLUME 3
N. D. Anoshchenko, ed. NASA Nov. 1967 45 p refs Transl. into ENGLISH of the book "Iz Istorii Aviatsii i Kosmonavtiki, Vyp. 3" Moscow, Izd. AN USSR, 1965
(Contract NASw-1497)
(NASA-TT-F-11429) CFSTI: HC $3.00/MF $0.65 CSCL 21A

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N68-13567*# Holman (John F.) and Co., Inc., Washington, D. C.
RAMJET ENGINES FOR SPACECRAFT
B. Stechkin *In its* Hist. of Aviation and Cosmonautics, Vol. 3 Nov. 1967 p 3 (See N68-13566 04-28)

Abstracted data on the area of application of the ramjet is presented. The use of ramjets for flight in the Mach number 1.5–7 range is indicated, and an upper limit of Mach number 12 is expected. It is pointed out that the use of ramjets for flight in space at altitudes of 90–100 km and speeds of Mach number 28 is still impossible, but may be possible soon for rocket launching. N.E.N.

N68-13568*# Holman (John F.) and Co., Inc., Washington, D. C.
THIRTY-FIVE YEARS AFTER THE CREATION OF THE THEORY OF AIR-BREATHING JET ENGINES BY ACADEMICIAN B. S. STECHKIN
Yu. A. Pobedonostsev *In its* Hist. of Aviation and Cosmonautics, Vol. 3 Nov. 1967 p 4–9 refs (See N68-13566 04-28)

The early jet engine development is outlined, and rigorous treatment by Stechkin in 1928 of the thrust and efficiency of the engine is emphasized. The principles of operation of the jet engine are briefly described. N.E.N.

N68-13569*# Holman (John F.) and Co., Inc., Washington, D. C.
SUPPLEMENT TO THE THEORY OF ACADEMICIAN B. S. STECHKIN ON THE CREATION OF RAMJET ENGINES
M. M. Bondaryuk *In its* Hist. of Aviation and Cosmonautics, Vol. 3 Nov. 1967 p 10–16 refs (See N68-13566 04-28)

The design and operational characteristics of ramjet engines are reviewed. The differences between the acceleration engine and the sustainer engines are outlined, and problems concerning efficient fuel combustion are discussed. Requirements imposed upon the engine design for hypersonic flight are considered. N.E.N.

N68-13570*# Holman (John F.) and Co., Inc., Washington, D. C.
THE FIRST EXPERIMENTAL INVESTIGATIONS OF RAMJET ENGINES BY "GIRD"
I. A. Merkulov *In its* Hist. of Aviation and Cosmonautics, Vol. 3 Nov. 1967 p 17–24 refs (See N68-13566 04-28)

The flight tests performed on the ramjet engines in the early 1930's are briefly described. In the first series of test artillery cannon were used for launching. White phosphorus grains were used as the fuel, and the fuel developments for increased efficiency are covered. Flight speeds in the supersonic range are reported. N.E.N.

N68-13571*# Holman (John F.) and Co., Inc., Washington, D. C.
FIRING OF THE WORLD'S FIRST RAMJET ROCKET
V. P. Kaznevskiy *In its* Hist. of Aviation and Cosmonautics, Vol. 3 Nov. 1967 p 25–30 refs (See N68-13566 04-28)

Supersonic ramjet rocket flight tests in the late 1930's are reviewed. The design of the rocket and performance predictions are briefly described. Several fuels were developed and combustion tests were also performed. Details on the flights are included. N.E.N.

N68-13572*# Holman (John F.) and Co., Inc., Washington, D. C.
FLIGHT TESTS OF THE RAMJET ON AIRCRAFT DESIGNED BY N. N. POLIKARPOV IN 1939–1940
A. Ya. Shcherbakov *In its* Hist. of Aviation and Cosmonautics, Vol. 3 Nov. 1967 p 31–38 refs (See N68-13566 04-28)

Design and testing leading to manned test flights of aircraft with ramjet engines are reported. The initial models and preflight wind tunnel tests are described, and results of the manned flights are tabulated. High altitude stratospheric flights and fabrication of air-tight cabins are also mentioned. N.E.N.

N68-13573*# Holman (John F.) and Co., Inc., Washington, D. C.
EXPERIMENTAL PREPARATION FOR FLIGHT TESTS OF THE RAMJET ENGINE IN AN AIRCRAFT DESIGNED BY A. S. YAKOVLEV IN 1942–1944
K. A. Putilov *In its* Hist. of Aviation and Cosmonautics, Vol. 3 Nov. 1967 p 39–44 (See N68-13566 04-28)

The initial firing tests are described, and the establishment, the conditions and characteristics which were to be studied in the ground tests are discussed. The results of wind tunnel tests are reported, and the problem areas which appeared are indicated. It is considered that the main result of the test-stand and flight testing of the ramjets was that they proved the correctness of the early theory and calculation methods. N.E.N.

N68-13576*# International Information, Inc., Philadelphia, Pa.
PRACTICAL SIGNIFICANCE OF THE SCIENTIFIC AND TECHNICAL PROPOSALS OF K. E. TSIOLKOVSKIY IN THE FIELD OF ROCKET ENGINEERING
Sergey Pavlovich Korolev *In its* Hist. of Aviation and Cosmonautics, Vol. 4 Nov. 1967 p 4–15 refs (See N68-13574 04-02)

A biographic sketch and a brief review of the contributions of Tsiolokovskiy, considered to be the father of Russian rocketry, are presented. The effects of gravity and means of combatting them were emphasized, and laws of rocket motion were developed. Launching problems, angle of climb, and separation were also considered. It is stated that a special feature of his works lay in the thorough elaboration of each problem. N.E.N.

N68-13620 Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
REDUCTION OF THRUST NOZZLE LOSSES IN JET ENGINES AT OVEREXPANSION BY VENTILATION OF THE DIVERGENT PART [VERRINGERUNG DER SCHUBDUES-ENVERLUSTE EINES STRAHLTRIEBWERKS BEI UEBEREX-PANSION DURCH BELUEFTUNG DES DIVERGENTEN TEILS]
H. Neumann Dec. 1966 101 p refs In GERMAN, ENGLISH summary
(OLR-FB-66-58) CFSTI: $3.00

For supersonic turbojet flight at high Mach number, a variable convergent–divergent nozzle is preferable. A convenient design practice would be to use aerodynamic contraction and a rigid

divergent adapted to normal flight conditions. The thrust losses caused by superexpansion may be reduced considerably by suction through perforations in the divergent part. The developed calculation method permits explanation of the tendencies and magnitudes of the experimentally established thrust losses. Such a nozzle is especially suitable for VTOL-aircraft because gas injection permits deviation of the jet. Author

N68-13633# Aeronautical Research Council (Gt. Brit.)
THE DESIGN-POINT PERFORMANCE OF MODEL INTERNAL-EXPANSION PROPELLING NOZZLES WITH AREA RATIOS UP TO 4
M. V. Herbert, D. L. Martlew, and R. A. Pinker London HMSO 1967 108 p refs Supersedes NGTE-R-258; ARC-26495 See X64-15752; X65-81318; N65-20659
(ARC-R&M-3477; NGTE-R-258; ARC-26495) HMSO: £2 1s

The construction of a new dry air thrust rig is described, for testing model propelling nozzles in quiescent air, and its pretensions to accuracy are examined. Use has been made of certain types of convergent nozzle as a means of checking the absolute level of air mass flow measurement. Experimental results have been obtained for the performance of a family of conically divergent nozzles running correctly expanded, and compared with theoretical estimates of the contributory losses. Other basic shapes of internal-expansion nozzle, both axisymmetric and two-dimensional, have also been tested. Author

N68-13649# Gesellschaft fuer Weltraumforschung m.b.H., Bad Godesberg (West Germany).
STATE OF DEVELOPMENT OF ELECTRICAL SPACECRAFT PROPULSION SYSTEMS IN THE FEDERAL REPUBLIC OF GERMANY
Johann Joseph Mader Oct. 1967 21 p refs Presented at the ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication
(GFW-TN-67/6) CFSTI: HC $3.00/MF $0.65

Electric propulsion systems and auxiliary power sources developed in the Federal Republic of Germany are reviewed. Studies and effort are specially devoted to latest types of solar cells, isotope generators, two of which are under study, and reactors with various conversion systems, and to the following electric engines: a mercury ion motor with high frequency ionization, a colloidal particle thrustor using mercury, a cesium contact ion engine, an MPD arc jet engine, and an arc ramjet. Author (ESRO)

N68-13655*# Alabama Univ., University. Bureau of Engineering Research.
ENGINE COMPONENT SIMPLICITY RATING
Wyllys G. Stanton Sep. 1967 168 p refs
(Contract NAS8-5262)
(NASA-CR-91471; TR-21) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A study was conducted to develop a system of simplicity ratings of components of rocket engines. The discussion covers different facets of design simplicity, variations of the basic proposition that what is simpler is better, and ways to achieve less complex designs. Author

N68-13733 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POWER EQUIPMENT MANUFACTURE Selected Articles
27 Mar. 1967 49 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 9, 1964 p 12–15, 15–18, and 23–26
(Contract AF 33(657)-16408)
(FTD-HT-66-364; AD-661903)

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N68-13734 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF DESIGN OF BURNER UNIT ON CHARACTERISTIC OF GAS-TURBINE COMBUSTION CHAMBER
V. A. Kristich, Yu. N. Bashkatov, Ye. N. Chernin, and A. M. Shevchenko *In its* Power Equipment Manuf. 27 Mar. 1967 p 1–13 refs (See N68-13733 04-28)

Design improvements to a premixing register burner were explored. The principal experiments were conducted at an air pressure of 1.5 atm, a temperature before the chamber of 300C, an air flow of 7–8 m^3/sec, and an air-fuel ratio of 4.5–20 (primary-air ratio was 1.1–5). Several burners were tested. Flow aerodynamics were investigated with a cold blowdown of the chamber. The best operating conditions of the flame tube were observed with nonregister-type diffusion burners. The intensity and completeness of combustion were also investigated, as well as combustion stability, pressure loss in the chamber, and the temperature field of exhaust gases. Author

N68-13736 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF A RADIAL AXIAL TURBOCOMPRESSOR TURBINE
L. N. Odivanov and A. P. Tunakov *In its* Power Equipment Manuf. 27 Mar. 1967 p 27–39 refs (See N68-13733 04-28)

A radial-axial-flow turbine (a part of a TKR-14 turbocompressor built by the Ural Turbomotor Plant) was experimentally investigated. Although the turbine had been designed for a pulsating gas flow, it was tested at a constant entrance pressure, and recommendations for improving the turbine efficiency under these conditions were drawn. The nozzle box assembly and the scroll were tested by the method of static blowdown. Inlet pressures were maintained within 1.39 to 1.59 kg/cm^2; static outlet pressure: 1.03 to 1.11 kg/cm^2; inlet gas temperature: 350 to 365K in cold tests and 820K in hot tests; speed: 17,000 to 40,000 rpm; and gas flow: 0.3 to 0.5 kg/sec. Losses in the turbine were found to be high. Design changes both in the nozzle box and in the rotor were recommended. Some of the recommendations were experimentally verified: the angle of incidence of the nozzle box was reduced to 15° and the blade profile was improved, which resulted in an 8% increase in the internal efficiency. Further design improvements brought the internal efficiency to 87%. Author

N68-13762*# Bendix Corp., Southfield, Mich. Research Labs.
ALL-FLUID AMPLIFIER DEVELOPMENT FOR LIQUID ROCKET SECONDARY INJECTION THRUST VECTOR CONTROL Final Report
J. T. Kasselmann and T. R. Delozier Nov. 1967 94 p refs
(Contract NAS3-6299)
(NASA-CR-72145; BRL-3875) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Experimental and analytical studies were conducted to develop the vortex amplifier as a hot gas valve for liquid rocket secondary

injection thrust vector control. This work included the staging of two vortex amplifiers in series to improve flow gain and the development of a new vortex-doublet type of gas generator designed for direct integration with the two vortex amplifier stages. The program final objective was to demonstrate a complete 2.0 lb/sec flow rate, staged, single-axis secondary injection thrust vector control system, under simulated rocket engine operating conditions. The staging of two vortex amplifiers in series to increase flow gain was established, and a flow gain of 200 was obtained. The vortex-doublet gas generator was successfully developed through a series of tests that established ignition, throttling, shutdown, and restarting with two sizes and two pressure levels. The potential of the staged vortex amplifier with integral gas generators in the secondary injection thrust vector control application was established. The performance of the vortex devices and the gas generators met specification without exception. Author

N68-13814*# National Aeronautics and Space Administration, Washington, D. C.

PROCEEDINGS OF THE JOINT MEETING OF THE COMMITTEE ON AIR BREATHING ENGINES AND THE SUBCOMMITTEE ON AERODYNAMIC MEASURING TECHNIQUES, HELD IN AACHEN, JULY 6, 1962 [BERICHT UEBER DIE GEMEINSAME SITZUNG DER AUSSCHUESSES LUFTANSAUGENDE TRIEBWERKE UND DES UNTERAUSSCHUSSES AERODYNAMISCHE MESSTECHNIK AM 6.7. 1962 IN AACHEN]

P. Stottmann, S. Foerster, G. Temme, W. Tombuelt, A. F. Eisfeld et al Aug. 1967 118 p refs Transl. into ENGLISH from WGLR Rept. No. 1/1963

(NASA-TT-F-11096; WGLR-1/1963) CFSTI: $3.00 CSCL 21A

Papers are presented on various aspects of aerodynamic measuring techniques, instruments, and equipment used in the development of air breathing engines. Temperature and pressure measuring problems are discussed and the application of specific instruments and test equipment is suggested. Design criteria for transducers, probes, sensors, and meters are given. Data recording requirements are outlined and wind tunnel simulation experiments are described. E.J.S.

N68-13839* LTV Aerospace Corp., Dallas, Tex. Missiles and Space Div.

FEASIBILITY STUDY FOR A 44-INCH FIRST STAGE ROCKET MOTOR Final Report

31 Aug. 1967 365 p refs

(Contract NAS1-6935)

(NASA-CR-66528; Rept.-23.324) CFSTI: $3.00 CSCL 21H

The primary purposes of this study are to evaluate the increase in capabilities of the Scout vehicle with a larger first stage motor and to evaluate the changes to the basic vehicle and to the operational and ground support equipment that result from the larger and greater-weight first stage motor. This report presents the results of the study for both the basic vehicle and the ground support equipment (GSE). Studies were conducted in the following tasks: (1) nominal elliptical performance; (2) definition of vehicle changes; (3) definition of GSE changes; (4) final performance analysis; and (5) sensitivity study using an alternate Algol performance. It is concluded that a 44-inch first stage rocket motor can be utilized on the current Scout system with minor modifications to the basic vehicle and the GSE. K.W.

N68-13841 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

NEWS OF SCHOOLS OF HIGHER EDUCATION. AERONAUTICAL ENGINEERING

21 Mar. 1967 266 p refs Transl. into ENGLISH from Izv. Vyssh. Uchab. Zaved., Aviats. Tekh. (Kazan), no. 4, 1964 p 1–143

(FTD-HT-66-260; AD-661889)

A compilation of aeronautical engineering articles is presented dealing with Soviet studies on flight control dynamics, systems analyses, shell theory, turbine operation and design, and flight and trajectory optimization. For individual titles, see N68-13842 through N68-13861.

N68-13850 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LOSSES OF FRICTION AND VENTILATION IN RADIAL TURBINE WHEELS OF HELICOPTER AND TRANSPORT GAS-TURBINE INSTALLATIONS [O POTERYAKH TRENIYA I VENTILYATSII V RABOCHIKH VENTSAKH RADIAL'NYKH TURBIN VERTOLETNYKH I TRANSPORTNYKH GTU]

N. F. Galitskiy *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 85–95 refs (See N68-13841 04-28)

In order to assess the power losses due to no-load rotation of the working rims of radial flow turbines, investigations were conducted on an experimental training installation for testing radial wheels. The working rim from a turbine having 208 blades, 7.7 mm wide and 18 mm long and with an external diameter of 366.4 mm, was attached to the shaft of a high frequency electric motor (9kw at 8000 rpm) and rotated in a medium of atmospheric air in forward and reverse directions at variable speeds. Experimental results are depicted in a logarithmic system of coordinates. It was established that the rate and direction of rotation, working blade length, working rim width, and flow-through section designs affect the friction and ventilation power values expended on the idling of the radial rim. Formulas and coefficients are proposed for computing the magnitude of the power expended on the idle rotation of radial rims in single- and multistage radial flow turbines. Author

N68-13851 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

MIXING OF PLANE-PARALLEL TURBULENT STREAMS [SMESHENIYE PLOSKO-PARALLEL'NYKH TURBULENTNYKH STRUY]

L. A. Zhukov, I. S. Makarov, and B. G. Khudenko *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 96–109 refs (See N68-13841 04-28)

Experimental results are presented on the mixing of two plane-parallel turbulent air jets discharging into the atmosphere from square nozzles, 10×40 mm in size, at velocities ranging from 20 to 56 m/sec. The distance between the nozzles was varied from 40 to 120 mm. The resulting concentration fields of an admixture gas (CO_2) during the mixing of the two jets was also investigated at a constant distance between the nozzles and at velocities of 20–30 m/sec. To shape the jets, they were discharged into a space enclosed between two plates. The measurements were taken at a distance of 400 mm from the nozzle. The initial jets contained 10% CO_2. The experimental data were treated mathematically in dimensionless parameters to obtain the total pressure, relative velocity, and rarefaction coefficient profiles for the resulting (mixed) flow. It is shown that the velocity distribution in the boundary layer during the mixing of the two jets has a universal character, with respect to both the mixing of two jets and the mixing of a jet with stationary air. Author

N68-13852 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILITY OF PROTECTIVE FILMS IN HEAT ENGINES [OB USTOYCHIVOSTI ZASHCHITNYKH PLENOK V TEPLOVYKH DVIGATELYAKH]

A. S. Lyshevskiy *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 110–122 refs (See N68-13841 04-28)

The stability of liquid films used for cooling liquid rocket combustion chambers or nozzles was theoretically analyzed, with the assumption that the liquid is weightless and incompressible and that the viscosities of the gas and liquid are negligible. The solution of the Laplace equation describing the propagation of a perturbation in the liquid film moving along a cylindrical surface yielded stability criteria, in terms of Bessel's functions and the Weber number, which were evaluated for longwave and shortwave perturbations. It is shown that axially symmetric oscillations are the least stable and lead most rapidly to a breakup of the liquid film. Further results showed that at small We values, the length of the continuous film increases with increasing We, whereas at large We values, when breakup is caused by shortwave perturbations, the length of the film decreases with increasing We. The results were found to be in fair agreement with previously published experimental data. Author

N68-13853 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPERATING CHARACTERISTICS AND METHOD FOR CALCULATING PARTIAL-ADMISSION MICROTURBINES [OSOBENNOSTI RABOCHEGO PROTSESSA I METODIKA RASCHETA PARTSIAL'NYKH MIKROTURBIN]

A. S. Natalevich *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 123–136 refs (See N68-13841 04-28)

Special features of the working process of partial-admission microturbines (less than 4 kw at 20,000 to 100,000 rpm) are analyzed. The following methods for increasing the efficiency of these turbines are discussed: increasing the rpm, using ejectors between the compressed air reservoir and the turbine inlet, using two turbine stages or replacing the second stage by two-speed one-ring turbines, utilizing shrouds, improving the aerodynamic characteristics of nozzle blade cascades, and using closed wheels. Methods for calculating single-stage microturbines and evaluating losses are given. These methods are suitable for both axial and radial microturbines. It is concluded that the profiling of microturbine blade cascades is analogous to the profiling of short blade cascades in impulse turbines. It has, however, a number of special features which should be individually considered. Author

N68-13854 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CALCULATION OF LEAKAGE LOSSES IN THE END CLEARANCE OF A RADIAL-AXIAL TURBINE [RASCHET POTER' OT UTECHKI V TORTSOVOM ZAZORE RADIAL'NO-OSEVOY TURBINY]

L. N. Odivanov *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 137–151 refs (See N68-13841 04-28)

An effort is made to find a new approach to the problem of estimating losses connected with the presence of end play. Experimental data available on the matter of end play and its effect on efficiency are generalized. Losses due to end play are divided into three types. A generalized formula is given for the calculation of the coefficient of additional losses in the wheel from the clearance. The analysis given indicates that as the smoothness of the flow bend in the wheel is improved and when working with smaller angles of attack, lower losses are observed, both due to clearance leakage and to flow bending in the wheel channel. It is also shown that disk losses in the vicinity of the clearance also increase as the end play grows larger. Author

N68-13858 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN EXPERIMENTAL INVESTIGATION OF THE CONFIGURATION OF SPRAY FROM A CENTRIFUGAL NOZZLE INJECTION FUEL INTO HIGH-TEMPERATURE AIRFLOW [EKSPERIMENTAL'NOYE ISSLEDOVANIYE KONFIGURATSII FAKELOV RASPYLA TSENTRO-BEZHNOY FORSUNKI PRI RASPYLIVANII TOPLIVA V POTOK VOZDUKHA VYSOKOY TEMPERATURY]

V. V. Uvarov *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 175–181 refs (See N68-13841 04-28)

A theoretical and experimental study was made of the spray flame formed by concurrent or countercurrent injection of jet fuel through a swirl atomizer into airstreams at 873° or 1173°K. Injection pressure in the nozzle (diameter, 2.5×10^{-3}m) was varied in the range from 4×10^5 to 36×10^5 n/m^2 (gage). The heated air stream passed through a converging duct into a constant cross-section duct equipped with three flow-rectifying grids and with temperature and pressure gages. The airstream was then passed through a converging section to the fuel injection nozzle. The stagnation temperature and static pressure of the airstream were measured, and the flame boundaries were photographed. The limiting diameter of the spray flame, calculated as a function of injection pressure, was found to be in good agreement with the experimental values. It is concluded that the formula can be used for high-temperature and high-velocity airstreams with counter-current fuel injection. Author

N68-13859 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPECTRAL ANALYSIS OF THE VIBRATIONS OF GAS TURBINE POWER PLANTS [SPEKTRAL'NYY ANALIZ VIBRATSIY GAZOTURBINNYKH DVIGATELEY]

D. I. Fedotov and A. A. Kosozhikhin *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 182–190 refs (See N68-13841 04-28)

Various methods for recording vibrations and the difficulties encountered in applying such recordings to the study of gas turbine vibration are discussed. The wider use of a method involving the analysis of vibration spectra is suggested and a gas turbine vibration analyzer is described. The most important feature of this analyzer is its production of amplitude-frequency spectrograms requiring no further processing. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-12821 Wisconsin Univ., Madison.

THE THEORETICAL BASIS FOR LOW-RESOLUTION RADIOMETER MEASUREMENTS FROM A SATELLITE

Verner E. Suomi, Kirby J. Henson, and Thomas H. Vonder Haar *In its* Studies in Atmospheric Energetics based on Aerospace Probings Mar. 1967 p 79–100 refs (See N68-12817 04-13)

The theoretical background is provided for obtaining irradiance values from low-resolution radiometers of the TIROS satellite series, in which hemispherical sensors were used. The theory for inflight calibration of the radiometers is developed. Such a calibration is possible from data obtained when the satellite crosses the earth's shadow, and the earth shades or unshades the radiometers from the direct sunlight. These inflight calibrations provide

information on degradation of the absorbing properties of the sensor surface. An important feature of this measurement system is that the radiant energy from a specific source which is absorbed by the sensor is used to determine the irradiance from that source, through a known geometrical relationship between the two. The radiation sources are direct solar radiation, reflected solar radiation from the earth, and IR radiation from earth. A necessary refinement to the calculation of irradiance is to reduce the irradiance value, determined for the height of the satellite, to some lower level, which more nearly corresponds to the top of the atmosphere. This refinement is included. ... Author

N68-12927# Aerospace Corp., El Segundo, Calif. Lab. Operations.
LOW ENERGY COSMIC RAY CUTOFFS: DIURNAL VARIATIONS AND PITCH ANGLE DISTRIBUTIONS
G. A. Paulikas, J. B. Blake, and S. C. Freden Oct. 1967 33 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-20)-2; SAMSO-TR-67-64; AD-661959)

Observation of solar protons in the 1 to 100 MeV interval during the solar proton event of September 2, 1966, shows that: (a) an important day-night asymmetry in the geomagnetic cutoffs exists, with the flux starting to decrease from the polar plateau value at higher invariant latitudes near the noon meridian than near the midnight meridian; (b) the asymmetry is more pronounced for the lower energy particles. Direct and indirect measurements of pitch angle distributions show that a quasi-trapped flux of protons is established at high altitudes on the dayside of the polar cap. The nonisotropic pitch angle distribution at invariant latitudes less than 75 deg near local noon is a manifestation of limited access of solar protons to some local times and is associated with the midday absorption recoveries observed with riometers.
Author (TAB)

N68-13008# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
A ROCKET MEASUREMENT OF LOW ENERGY PROTONS
George A. Kuck Aug. 1967 13 p refs *Its* Environ. Res. Papers, No. 271
(AFCRL-67-0461; AD-661562)

The proton energy spectra from L = 2 to L = 3 were measured by a two-detector solid-state telescope carried by a rocket launched on 30 March 1965. The spectra were found to be well fitted by single exponentials of the form exp (-E/E sub 0) for the two energy regions 0.2 = or < E = or < 1.5 MeV and 1.5 = or < E = or < 4.0 MeV. The energy parameter was found to be 0.4 = or < E sub 0 = or < 1.2. The spectra were L dependent and in qualitative agreement with the inward radial diffusion theory.
Author (TAB)

N68-13319 Atomic Energy of Canada, Ltd., Chalk River (Ontario).
COSMIC RAY NM-64 NEUTRON MONITOR DATA-7 Monthly Graphs, Jan.–Aug. 1967
J. F. Soules Oct. 1967 75 p
(AECL-2765)

Uncorrected and barometer-corrected results from the cosmic ray stations in Canada using equipment maintained by AECL are given in tabular form for the period from May to August 1967. Normalized graphs are given for the period January 1967 to August 1967. A warning about defective barometer vacuum at two stations is included.
Author

N68-13463# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
RADIO ASTRONOMY
A. H. Barrett, B. F. Burke, L. B. Lenoir, D. H. Staelin, S. H. Zisk et al *In its* Quart. Progr. Rept. No. 87 15 Oct. 1967 p 5–15 refs (See N68-13461 04-23)
(Contract NSR-22-009-120; Grants NSG-419; NSF GP-7046)

Recent measurements of the cosmic microwave background with a radiometer configuration, calibrated with liquid helium, indicated a background temperature of 3.2±0.8°K at 9.24 mm (32.5 GHz). Observations were made between June 28 and July 11, 1967, in California. Interferometric measurements on OH emission sources associated with H II regions exhibited polarization properties, anomalous intensity ratios, and narrow linewidths. The strongest emission complex was associated with the radio source W3; its strongest feature, at a radial velocity of −45.1 km/sec, is unresolved with a 700,000 wavelength baseline. Results were obtained by using a 120-ft telescope and a 140-ft telescope with a separation of 845 km, or 4.7×10^6 wavelengths at 1665.4 MHz which corresponded to a fringe spacing of .044 second of arc. Frequency data were recorded on magnetic tape through a computer that serviced the antenna, recorded video signals were cross correlated at certain delay intervals and converted to time-independent functions.
G.G.

N68-13579*# Minnesota Univ., Minneapolis. Cosmic Ray Group.
THE OBSERVATION OF 10–50 KEV SOLARFLARE X-RAYS BY THE OGO SATELLITES AND THEIR CORRELATION WITH SOLAR RADIO AND ENERGETIC PARTICLE EMISSION
R. L. Arnoldy, S. R. Kane, and J. R. Winckler Sep. 1967 45 p refs Presented at the Intern. Astron. Union Symp. No. 35 on the Struct. and Develop. of Solar Active Reg., Budapest, 4–8 Sep. 1967
(Contract NAS5-2071)
(NASA-CR-91510; CR-107) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Since September 1964 ionization chambers flown in space have detected numerous solar flare x-ray bursts in the energy range from 10 to 50 Kev originating in solar flare disturbances. In the present paper we shall present the most recent summary of these observed events and discuss their relationship with the microwave solar radio bursts and with the observations of energetic electrons and protons ejected into space by the same flares. The central object of such a study is to reach a better understanding of the solar flare processes and the nature of the instabilities which generate flares but, in particular, to understand the processes which gave rise to suprathermal particles so frequently observed in flares.
Author

N68-13647# Royal Inst. of Tech., Stockholm (Sweden). Plasma Physics Div.
THE SECOND APPROACH TO COSMICAL ELECTRODYNAMICS
H. Alfven 1967 18 p refs Presented at the Birkeland Symp., Sandefjord (Norway), Sep. 1967
(Rept.-67-18) CFSTI: HC $3.00/MF $0.65

For the approach to electromagnetic phenomena in the cosmos starting from non-linear models there are three new principles. Because of the very good electric conductivity in most cosmic problems the models have used the concept of 'frozen-in magnetic field lines. This concept has, however, proved some limitations in that there often exist electric fields with components parallel to the magnetic field, therefore a first new principle is associated with a 'thaw' of the frozen-in field lines. The second principle concerns the homogeneity of the models, homogeneous in the sense that they take no account of the filamentary structure. It is now evident that such models do not give an approximate

description of the essential phenomena and they must be replaced by models in which major importance is attributed to the microstructure of the field. One may characterize this principle as a 'bunching' of field lines. The third new aspect is associated with the Maxwell equation and to some extent with the 'bunching'. In many cases the physical basis of the phenomena are better understood by depicting the electric current lines than the magnetic field lines. ESRO

N68-13650# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.

CURRENTS IN THE IONOSPHERE AND MAGNETOSPHERE

Rolf Bostroem Sep. 1967 33 p refs Presented at the Birkeland Symp., Sandefjord (Norway), Sep. 1967

(Rept.-67-17) CFSTI: HC $3.00/MF $0.65

Three dimensional model current systems are discussed, in which magnetospheric and ionospheric sections are connected by currents flowing along the geomagnetic field lines. A model of this kind was first proposed by Birkeland to explain polar elementary storms. Many recent model current systems, such as those proposed for bays and the asymmetric phase of storms, contain field aligned contributions. It has been shown that the currents in these models may produce magnetic perturbations similar to those observed. The elementary physics of the ionospheric-magnetospheric current circuit is discussed, with emphasis on the production of field aligned currents. Among the physical processes that may drive the currents, pressure gradients in a hot magnetospheric plasma seem to be most powerful. Effects of gradients in the streaming velocity of the plasma are also treated. Author (ESRO)

N68-13651# Royal Inst. of Tech., Stockholm (Sweden). Plasma Physics Div.

RADIAL DIFFUSION BY VIOLATION OF THE THIRD ADIABATIC INVARIANT

Carl-Gunne Faelthammar Aug. 1967 23 p refs Submitted for publication

(Rept.-67-16) CFSTI: HC $3.00/MF $0.65

Violations of one or more of the adiabatic invariants, required for diffusion and acceleration of magnetically trapped particles, can occur as a consequence of electromagnetic fields with appropriate variations in space and time. Thus, waves with frequencies in the gyrofrequency range can change the magnetic moment, and waves in the bounce frequency range can violate the second adiabatic invariant. The third adiabatic invariant can be violated by field variations on the time scale of the azimuthal drift period. Generally speaking, whichever is the main contribution to the diffusion, one would expect that the diffusion coefficient is energy-dependent, and that its radial dependence need not necessarily be L^{10}. For particles of given energy, the diffusion coefficient associated with magnetic disturbances is a strongly decreasing function of mirror latitude. On the other hand, the diffusion coefficient associated with electric potential fields is expected to be insensitive to the mirror latitude. ESRO

N68-13780# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE PRODUCTION OF COSMIC GAMMA RAYS IN INTERSTELLAR AND INTERGALACTIC COSMIC-RAY COLLISIONS. 2: THE EFFECTS OF THE DECAY OF NUCLEON ISOBARS AND HYPERONS ON THE COSMIC GAMMA-RAY SPECTRUM

F. W. Stecker, S. Tsuruta, and G. G. Fazio 18 Dec. 1967 38 p refs

(SAO Special Rept.-259)

In interstellar and intergalactic cosmic-ray proton–proton collisions it is possible to produce nucleon isobars and hyperons that carry off a large fraction of the energy available in the collision. The delayed gamma rays that result from the decay of these particles also carry a large fraction of the available gamma-ray energy. We have calculated the galactic gamma-ray spectrum due to the decay of the nucleon isobars $N^*_{1/2}$ (1.410) and $N^*_{1/2}$ (1.688), for which the excitation involved no change of isotopic spin or strangeness, and due to the decay of hyperons (Λ, Σ^+, Σ^0). Results show that these reactions may be an important source of gamma rays of energy greater than 6 TeV (6×10^{12} eV). Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-12811# Sandia Corp., Albuquerque, N. Mex.

BOUNDARY CONDITIONS FOR PERSISTENT ROLL RESONANCE ON RE-ENTRY VEHICLES

Harold R. Vaughn May 1967 39 p refs

(Contract AT(29-1)-789)

(SC-RR-67-287) CFSTI: HC $3.00/MF $0.65

The boundary conditions that determine whether transient roll resonance, or the more serious persistent roll resonance, will occur on a reentry vehicle are determined theoretically for the condition of small angle of attack. Author (NSA)

N68-12861* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

MASSIVE STARS

Richard Stothers [1967] 41 p refs Submitted for publication

(NASA-TM-X-60774) CFSTI: $3.00 CSCL 03A

Developments in studying massive stars are reviewed, with particular emphasis placed on theoretical results which may be directly compared with observational data. Consideration is given to the basic assumptions usually made in constructing models for massive stars, the initial luminosity function as a tool for investigating stellar evolution, the salient features of homogeneous and inhomogeneous evolution, stellar lifetimes, the possibility of extensive mass loss from massive stars, pulsational instability, evidence for extremely high masses among observed stars, and supernovae. A bibliography is included. M.G.J.

N68-12888*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ERROR ANALYSIS FOR IMP D AND E

W. D. Kahn, J. L. Cooley, A. Marlow, and F. O. Vonbun Dec. 1964 21 p refs

(NASA-TM-X-63024; X-513-64-390) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Two error analyses consider the effects of injection errors separately and also the combined effects of injection and tracking system errors. For the latter study, tracking of the satellite in its transfer orbit is simulated by a tracking network composed of four range and range rate trackers. For both studies the RMS errors in spacecraft position and velocity are propagated up to lunar distance. Tracking of the satellite for the second study is simulated for five-minute periods at the end of three-hour periods of no tracking. A third error analysis study considers tracking the satellite in its lunar parking orbit. This study combines the effects of insertion and tracking system errors. Tracking is simulated by three Range

and Range Rate Systems for five-minute periods at the end of nine-hour periods of no tracking. The study considers tracking the satellite for 110 hours, or approximately 4.6 days. Author

N68-12902*# Bureau of Mines, Minneapolis, Minn.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Quarterly Status Report, 1 Jul.–1 Oct. 1967
Thomas C. Atchison 1 Oct. 1967 42 p ref
(NASA Order R-09-040-001)
(NASA-CR-91290) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Progress is reported on multidisciplinary research in the areas of collection and physical properties of simulated lunar materials; chemical reactivity and cold welding of freshly formed surfaces; physical properties of rock in lunar environment; fracture and other failure mechanisms in lunar environment; thermophysical, strength, and elastic properties of rock at high and low temperatures in vacuum; rock vaporization, melting, and thermal fracturing mechanisms in vacuum; cuttings removal and cooling and lubricating bits in drilling in lunar environment; lunar environment effect on fine particle behavior; support for underground lunar shelter; vacuum effect on explosive properties; micrometeoroid bombardment effect on explosives; explosive blast effects in lunar environment; volcanism and ore genesis as related to lunar mining; silicate reduction with carbon and in plasma torch; magnetic and electrostatic properties of minerals in vacuum; biological production of sulfuric acid; electrowinning of oxygen from silicate rocks; and stability of hydrous silicates and oxides in lunar environment. R.N.A.

N68-12908*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR ORBITER DATA ANALYSIS
J. Lorell and W. L. Sjogren 15 Nov. 1967 18 p refs
(Contract NAS7-100)
(NASA-CR-91374; JPL-TR-32-1220) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Lunar Orbiter tracking data were consistently characterized by large Doppler residuals near pericynthion. Attempts to explain this phenomenon led to an intensive investigation of possible causes, covering numerical procedures, instrument operation, and physical model. Author

N68-12931* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
HOT, VIBRATING NEUTRON STARS
A. Finzi and R. A. Wolf (Bell Telephone Labs.) [1967] 44 p refs
(NASA-TM-X-60773) CFSTI: $3.00 CSCL 03A

Taking into account the dissipative effect of neutrino-producing reactions, we calculate the amount of thermal and vibrational energy that can be present in a neutron star at a time t after its creation in a supernova explosion. The results are used to discuss the plausibility of a number of hypotheses advanced in recent years concerning possible observable properties of neutron stars. Author

N68-12956* TRW Systems, Redondo Beach, Calif.
THE STUDY OF MECHANICAL SHOCK SPECTRA FOR SPACECRAFT APPLICATIONS Final Report, Apr. 29, 1966–Apr. 29, 1967
29 Apr. 1967 165 p refs
(Contract NAS5-10166)
(NASA-CR-91356) CFSTI: $3.00 CSCL 22A

A computer program was developed to compute response spectra in terms of one of several response parameters or Fourier spectra. Since the primary purpose was the analysis of transient flight data, it was designed to process large quantities of information rapidly and economically. Operating time for the new program was observed to be less than one-tenth that of a spectral program. Improved techniques were studied for the specification of environmental tests to simulate limited duration flight loads. A rational basis for the use of response spectral analysis in test specification work is used to evaluate laboratory environments and tested against the results of an analysis utilizing several multidegree of freedom systems. It is concluded that response spectral analysis has use for test specification work, but should be augmented by other forms of analysis. The use of conventional sine-sweep tests for simulating flight transients should be reviewed, and the use of short duration tests should be considered. Author

N68-12966* California Univ., Berkeley. Space Sciences Lab.
CALCULATIONS OF THE EFFECT OF ROUGHNESS ON MICROWAVE EMISSIVITY WITH APPLICATION TO THE MOON AND VENUS
D. G. Rea, N. Hetherington, and R. Mifflin 10 Nov. 1967 104 p refs *Its* Space Sci. Lab. Ser. No. 8, Issue No. 101
(Grant NsG-101-61)
(NASA-CR-91355) CFSTI: $3.00 CSCL 03B

The relative advantages of models based on physical and on geometric optics are discussed and, based on its simplicity and ease of application, the geometric optics approach is used to calculate the effect of roughness on microwave emissivity. The calculations are performed for several emission angles relative to the normal to the average surface, and for the two planes of polarization in and perpendicular to the plane containing the emitted ray and the normal to the average surface. The integration programs for emissivities, convolution to simulate beam smoothing, and the differential polarization visibility function are provided. These geometric optics procedures are applied to interpreting emission and reflection data from the Moon and Venus. Although the approach is considered satisfactory, it is emphasized that, even with the inclusion of roughness, discrepancies between active and passive microwave determinations of the dielectric constants remain for both the Moon and Venus. M.G.J.

N68-13017*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
JOVIAN PLANET MISSIONS FOR SOLAR CELL POWERED ELECTRIC PROPULSION SPACECRAFT
Charles L. Zola Washington 1968 14 p refs Presented at 6th Aerospace Sci. Meeting, New York, 22–24 Jan. 1968 Sponsored by AIAA
(NASA-TM-X-52379) CFSTI: HC $3.00/MF $0.65

A preliminary analysis of multi-mission capability is made for a solar-electric spacecraft. The spacecraft has a 10 kilowatt, 345 kilogram propulsion system and uses the same thrustor specific impulse for all missions. A common launch vehicle (Atlas–Centaur) is used to start the spacecraft on a high energy Earth departure path for flyby and elliptic capture missions to Jupiter, Saturn, Uranus, and Neptune. The electric propulsion trajectories are calculated with optimal control of thrust vector direction but thrust magnitude is changed to account for solar cell power variation with distance from the Sun. Total propulsion time is limited to 800 days or less. Results show that, for all planets beyond Jupiter, high travel angle trajectories of more than one revolution about the Sun are necessary for payloads in excess of 200 kilograms. Author

N68-13021* Lockheed Missiles and Space Co., Sunnyvale, Calif.
PLANET GEOMETRIC CENTER TRACKER, VOLUME 1 Final Report, Oct. 1964–Jul. 1967

W. H. Aiff, A. R. Kraemer, and E. G. Fleenor 31 Aug. 1967 44 p refs
(Contract NAS2-2485)
(NASA-CR-73162; LMSC-678162, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 03A

The tracker locates the geometric center of Mars, Venus, or Jupiter with angular accuracy on the order of 1 arc second, regardless of whether the planet appears gibbous or crescent-shaped. The tracker functions over the full range of illuminations and radii for these three planets. The basic scheme involves the use of a roulette type circular scan, constrained to be circular, around the planet's edge and evaluation of the harmonic content of the signal generated by the tracker detector, an image dissector. The expected performance of the tracker was analyzed using an analog simulator and digital computer. The predicted performance exceeded all requirements. The actual performance was determined with the breadboard tracker using an LMSC 40-foot collimator with focal plane translation of planet masks to simulate actual planet geometry. The tracker performed almost as well as predicted and the results firmly establish the practical basis for this technique to be used in operational hardware. Author

N68-13022* Lockheed Missiles and Space Co., Sunnyvale, Calif.
PLANET GEOMETRIC CENTER TRACKER. VOLUME 2: SCAN OPTIMIZATION STUDY
P. J. Marra and A. R. Kraemer 31 Aug. 1967 44 p
(Contract NAS2-2485)
(NASA-CR-73163; LMSC-678162, V. 2) CFSTI: $3.00 CSCL 03A

Parameters are defined for an output waveform used in developing a scan pattern for locating the geometric, rather than the luminous, center of a planet through all its phases. A mathematical model was constructed to provide for maximum signal to noise ratio and the least inherent absolute error. It was found that the planet tracker scanning system could be modified to produce the desired waveform and this was used in a computer analysis of edge tracking optimization. Assuming four samplings of the planet's edge, this scan pattern tracked the fully illuminated planet with zero error. However, when applied to a gibbous planet with a decentration of .8, a shift error of 7.5% of the planet's radius was detected. Doubling the sample reduced the error to 5%. E.J.S.

N68-13025# Boeing Scientific Research Labs., Seattle, Wash.
THERMAL BEHAVIOR OF ROCKS ON THE LUNAR SURFACE
Edmond C. Roelof Sep. 1967 69 p refs Submitted for publication
(D1-82-0641; AD-661388)

The thermal behavior of rocks with sizes between 3 millimeters and 3 meters resting on the lunar equator is analyzed during both lunation and eclipse assuming that they emit and absorb radiation according to the Stefan-Boltzmann law. Thermal parameters for the rocks are taken as those of a typical basalt, a choice consistent with the interpretation of the Luna X gamma-ray experiment. Thermal heat exchange between rock and lunar soil is negligible for meter rocks during lunation (and eclipse) and sub-meter rocks during eclipse, but is significant during lunation for rocks < or equivalent 10 cm. Partial imbedding of sub-meter rocks tends to reduce the rock-soil temperature differential during lunation and to keep them warmer than exposed rocks during eclipse. The presence of neither sub-meter rocks (with size-distributions as observed by Surveyor I and III) nor meter rocks should have large effects on earth-based thermal measurements during lunation. During eclipse, sub-meter rocks can produce small but detectable variations in both earth-based and direct, local spacecraft environs measurements. Meter rocks near a spacecraft may emit equivalent 10 times the energy of the surface viewed at lunar sunrise or sunset and hence must be reckoned with when local thermal measurements are interpreted. Author (TAB)

N68-13035# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
NATURAL ORBITS OF THE FIRST KIND IN THE RESTRICTED PROBLEM
Andre Deprit and Arnold Rom Sep. 1967 67 p refs *Its* Math. Note No. 531
(D1-82-0651; AD-661389)

Lindstedts method is applied to expand analytically the natural families of periodic orbits of the first kind in the restricted problem of three bodies. The mass ratio is kept as a literal variable; the series proceed in the powers of Hills ratio of periods. They cover all four cases at once, namely the direct or retrograde orbits for either inferior planets or for satellites. When the mass ratio is given a numerical value, the expansions contain less terms and thus can be carried up to degree 17 within a 32K core of an IBM 7094. For the system Sun-Jupiter, the initial conditions provided by the series have been corrected to yield the beginnings of all four natural families, and the characteristic exponents have been computed. Comparison between the values computed out of the series and their improvement by numerical integrations and successive variational corrections show that, within an accuracy of one part in ten thousand, the series represent moderately well even the orbit of J VIII; the retrograde planetary orbits are fairly well covered up to 90% of the distance from Sun-Jupiter, whereas the direct planetary orbits are covered only up to 60% of that distance. Author (TAB)

N68-13046* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEYOR V MISSION REPORT. PART 2: SCIENCE RESULTS
1 Nov. 1967 190 p refs
(Contract NAS7-100)
(NASA-CR-91361; JPL-TR-32-1246) CFSTI: $3.00 CSCL 22A

Television observations from Surveyor V spacecraft are summarized in terms of the landing site and its topography, morphology and distribution of craters, thickness of lunar regolith, surficial debris layer, and size-frequency distribution of fragmental debris. Photometric and geological observations are discussed. Lunar surface mechanical properties are considered in light of dynamic simulations, soil characteristics and spacecraft slide, spacecraft landing, and lunar soil erosion testing. Lunation and eclipse data as well as albedo, lunar surface temperatures, and thermophysical properties are noted. Preliminary results are included for the chemical analysis of the moon at the Surveyor V landing site, and a magnet experiment to determine lunar surface electromagnetic properties is detailed. Lunar theory and processes are considered, and contamination at the landing site from the main retro exhaust is reported. M.W.R.

N68-13074# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MAGNETIC WALLS OF A COSMIC SHIP [MAGNITNYYE STENKI KOSMICHESKOGO KORABLYA]
A. Petrov 31 Mar. 1967 9 p Transl. into ENGLISH from Nauchn.-Tekhn. Obshchestva SSSR (Moscow), no. 6, 1964 p 80-81
(FTD-HT-66-440; AD-661768)

The popular-science article deals with the protection of spaceships and their crews from ionizing radiation and charged particles through magnetic fields created by superconducting alloys. TAB

N68-13079*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PLANETARY QUARANTINE: TECHNIQUES FOR THE PREVENTION OF CONTAMINATION OF THE PLANETS BY UNSTERILE SPACEFLIGHT HARDWARE
Charles W. Craven and Robert P. Wolfson (GE) 15 Dec. 1967 19 p refs
(Contract NAS7-100)
(NASA-CR-91343; JPL-TR-32-1216) CFSTI: HC $3.00/MF $0.65 CSCL 22A

System engineering techniques have been employed to: identify possible sources of contamination; develop required mathematical modeling; and specify tests required to furnish experimental data for system trade-off studies. The mathematical models developed in the study have made possible several sensitivity simulations. These have indicated the importance of the contamination problem and have also pointed out areas where further experimental data or analytical work will be useful. From this study, it will be possible to identify the most likely sources of contamination and to indicate corrective action. Knowledge from these studies can be applied to such questions as: aim-point philosophy to be followed in the launch trajectory; the need for decontamination or sterilization of the attitude control gas systems; the recommendation of cleanliness levels during the manufacturing cycle; and whether decontamination or sterilization will be necessary to achieve the required planetary quarantine goal. Author

N68-13084# Boeing Scientific Research Labs., Seattle, Wash. Information Sciences Lab.
PRINCIPLES OF EARTH-ORBITAL NAVIGATION
J. S. Meditch Sep. 1967 64 p refs
(ISR-5; AD-661391)

A tutorial presentation of the theory of earth-orbital navigation is given. The treatment begins with a summary of results from optimal filter theory for discrete-time linear systems. It is shown how these results can be applied to develop a data filtering algorithm for a certain class of discrete-time nonlinear systems. The latter results are then applied to obtain an algorithm for earth-orbital navigation. A discussion of certain specific aspects of the navigation algorithm is given in terms of its computational problems, the choice of coordinate systems, force models, and navigation measurement configurations. Although primary attention is given to self-contained navigation systems for use on-orbit, the general formulation is applicable to a variety of space missions. Author (TAB)

N68-13102# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
GEMINI V D4/D7 SPECTRAL MEASUREMENTS OF SPACE OBJECTS AND EARTH-CLOUD BACKGROUNDS
J. Lovett, L. Marcotte, and R. Nadile Oct. 1967 69 p refs *Its* Surv. in Geophys. No. 198
(ARPA Order 363; Proj. Vela-Uniform)
(AFCRL-67-0563; AD-661559)

Results of the radiometric and interferometric optical measurements performed by the crew of Gemini V during the D4/D7 experiment are presented. With use of a rapid-scan Michelson PbS interferometer and two radiometer channels filtered at 2.2 microns and 4000A, measurements of earth and lunar reflected sunlight are compared to those obtained on the Gemini VII flight. Also included are detailed calibrations of the D4/D7 instrumentation used on Gemini V. Author (TAB)

N68-13229# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WALKING ABOVE THE EARTH [SHAGI NAD ZEMLEY]
A. Yefim'yev 8 Mar. 1967 13 p Transl. into ENGLISH from Nauchn.-Tekhn. Obshchestva SSSR (Moscow), no. 5, 1965 p 6-8
(FTD-HT-66-443; AD-661993)

A description is given of the manner in which A. Leonov performed his walk in space. The spacesuit worn by Leonov is presented as a complex engineering scheme involving the color of the suit, the light filters protecting the astronaut from solar radiation, the self-contained oxygen-supply system, ventilation, its own power supply network to meet communications requirements, and the physiological control system. The spacesuit is made from rubber, fabrics, metal, synthetic materials, and consists of a metal helmet with transparent visor, an airtight suit, and special shoes and gloves. An umbilical cord is connected to the spacesuit, providing it with oxygen for breathing and air for ventilation of the suit. This extremely durable and elastic cable also contains flexible wires for transmitting telemetering data and maintaining communications with the spacecrafts commander and with ground stations. During the tests, physiologists decided to remove the nitrogen from the astronauts body before he left the air lock, thus making it possible to lower barometric pressure in the spacesuit to 0.4 atm without endangering the life of its occupant. It was found that the breathing of pure oxygen for over 1 hour literally washes all nitrogen from the tissues. The astronauts collaborated with designers and engineers in solving many of the complex design problems of the Voskhod-2 spacecraft. TAB

N68-13241* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
ULTRAVIOLET DWARFS AND PLANETARY NEBULAE
Richard Strothers Dec. 1967 38 p refs Submitted for publication
(NASA-TM-X-60768) CFSTI: $3.00 CSCL 03B

This paper is concerned primarily with the observational evidence leading to a determination of the lifetimes of ultraviolet dwarfs and the nuclei of planetary nebulae. Comparison of the observational lifetimes with the lifetimes calculated from theoretical stellar models suggests that neutrino emission is playing an important role in speeding up evolution in these stars. Other kinds of evidence are also adduced in favor of neutrino emission. The conclusion is that a direct electron-neutrino interaction actually exists in nature. Author

N68-13248*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ASPECT DETERMINATION IN LUNAR SHADOW ON EXPLORER 35
Harold E. Taylor Dec. 1967 18 p refs
(NASA-TM-X-63055; X-612-67-611) CFSTI: HC $3.00/MF $0.65 CSCL 22C

An empirical approach is taken toward the problem of correcting the azimuthal orientation of the Explorer 35 satellite during its passes behind the moon where it can no longer use the sun as a reference. The parameters used in calculating three free parameters in 1 are listed, and the problem becomes one of fitting a spin period of the form 1 to the satellite data. Three independent equations are required to determine the three free parameters. In two, the spin period before and after the shadow must be equal to that measured. The third condition is that the integrated number of revolutions between the true sun times be equal to that achieved by the satellite. The accuracy of the method is estimated to be $\pm$ 5° to 10°, but can only be checked empirically if it is assumed that the magnetic field does not change direction. The largest error would occur sometime during the shadow, since at the beginning and the end the orientation has been fitted to the true direction obtained by real sun sightings. M.G.J.

N68-13262*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
OXYGEN AND CARBON MONOXIDE COOLING IN PLANETARY THERMOSPHERES

Richard W. Stewart [1967] 34 p refs Work conducted in part by Columbia Univ.
(Grant NsG-445)
(NASA-TM-X-60766) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A study of the effectiveness of atomic oxygen and carbon monoxide as cooling agents in a planetary thermosphere is carried out. Analytic expressions for the total flux radiated by these constituents are derived based on the assumption of a sharply defined radiation zone in which the scale height variation is linear. It is found that the total flux radiated by atomic oxygen can exceed that radiated by carbon monoxide if the temperature in the radiating region is less than 300°K. The time-dependent thermal conduction equation is considered briefly. It is shown that the cooling time for carbon monoxide is of the order of a few hours, in contrast to the several-day cooling time of atomic oxygen. A substantial overnight cooling is thus to be expected in planetary thermospheres which contain carbon monoxide. Author

N68-13302# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Solid State Physics Research Lab.

APPLICATIONS OF THE SEQUENTIAL LIGHT AMPLIFIER TO ASTRONOMY AND RELATED PROBLEMS

Radames K. H. Gebel, Roy R. Hayslett, and Lloyd R. Wylie (Wittenberg Univ.) Aug. 1967 34 p refs
(ARL-67-0165; AD-661564)

The recording speed of a well-built sequential light amplifier is determined by comparison with photographic films and found to be about 10 to the 7th power asa. Therefore, for the next favorable opposition of Mars, exposure times of one millisecond become possible for pictures in color or in a narrow spectral region (delta lambda = 100A) when using a 200 inch telescope. The light amplifier permits contrast enhancement in the pictures and the short exposure times should yield sharper pictures, since the effect of changes in the diffraction of the air may, to a large extent, be voided in this way. It is calculated that the absolute theoretical limit of the sequential light amplifier as determined by quantum mechanics by using a 50 inch telescope outside the earth's atmosphere and one hour exposure time is about 32nd apparent magnitude. Author (TAB)

N68-13307# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.

THEORETICAL RESEARCH IN ASTROPHYSICS Final Status Report, 1 Apr. 1965–15 Sep. 1967

Thomas Gold 15 Sep. 1967 18 p refs
(Contract AF 40(638)-1527)
(CRSR-284; AFOSR-67-2614; AD-661573)

Theoretical research in astrophysics for the period from 1 April 1965 to 15 September 1967 is summarized. The following topics are included. (A) Theory of quasars and strong radio sources. (1) Evolution of dense star systems; (2) Dynamics of stellar collisions; (3) Light fluctuations in quasars; (4) Structure of radio sources; (5) Thermal instability due to synchrotron radiation; (6) Cosmic ray electrons and positrons; (7) Quasars and ghost images; (8) Radiative transfer of x-rays; (9) Intergalactic absorption lines. (B) dynamics of HII regions. (1) Similarity solutions for the expansion of HII regions; (2) Stability of ionization fronts; (3) Recombination fronts in stellar wind flow; (4) Destruction of interstellar molecules; (5) Maser action in interstellar OH. (C) Stellar winds. (1) Blast waves in stellar wind flows; (2) Whistlers transonic flow in stellar winds; (3) The effect of cosmic ray pressure gradients on the solar wind. (D) Plasma physics. (1) Non-linear plasma oscillations. Author (TAB)

N68-13335 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTRIBUTION FUNCTION OF VELOCITIES IN A NON-ROTATING STELLAR SYSTEM AND ENERGY TAKEN AWAY DURING DISSIPATION [FUNKTSIYA RASPREDELENIYA SKOROSTEY V NEVRASHCHAYUSHCHEYSYA ZVEZDNOY SISTEME I ENERGIYA UNOSIMAYA PRI DISSIPATSII]

V. J. Kaliberda *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 151–158 refs (See N68-13323 04-19)

An attempt is made to obtain more accurate evaluation of energy losses in a system during its dissipation and to clarify the significance of this factor in the evolution of stellar systems. Velocity distribution functions are plotted and calculated with consideration given to the effects of multiplicity of stellar encounters. The value $dE=0.0012E$ is obtained for energy lost to dissipating bodies during time dt, where E is the energy of the system, and $E/E=0.124$ for energy lost to dissipating bodies in relation to their energy prior to separation from the system. It is concluded that energy of a binary star has an absolute magnitude which is twice as high as the initial energy of condensation. Author

N68-13336 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPTIMUM COPLANAR FLIGHT BETWEEN ORBITS [OPTIMAL'NYY KOMPLANARNYY POLET MEXHDU ORBITAMI]

S. N. Kirpichnikov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 159–173 refs (See N68-13323 04-19)

Calculations are presented for a coplaner flight between fixed orbits and it is assumed that initial thrust produces a minimal magnitude of characteristic velocity and insures minimal consumption of fuel. Initial, intermediate and final trajectories are assumed in the form of Keplerian orbits. The author ignores time elements or considers them for all three trajectories, presenting an analysis of a flight between circular and slightly eccentric orbits. Author

N68-13344 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TEMPERATURES OF HOT WHITE DWARFS [O TEMPERATURAKH GORYACHIKH BELYKH KARLIKOV]

A. K. Kolesov *In its* Leningrad Univ. Herald. Math., Mech. and Astronomy Ser., V. 19, No. 1 20 Apr. 1967 p 223–227 refs (See N68-13323 04-19)

The same methods employed for main sequence stars have generally been used for determining the surface temperature of the white dwarfs. This is interfered with, however, by the peculiarities of the white dwarf spectra caused by their high atmospheric densities and possibly by variations in their chemical composition. The white dwarf spectra may be divided into two groups: the DA stars in which there are hydrogen lines but no helium lines, and the DO and DB stars in which there are only helium lines. The author calculates the energy distribution and theoretical spectra for models of pure hydrogen and pure helium atmospheres, ignoring the effect of absorption lines, and tabulates the results in relation to the mass and temperature of the star. Since the value of U-V was found to be essentially independent of stellar mass for large masses, this can be taken as an index of surface temperature. The observed values for U-V for 20 white dwarfs were therefore compared with the theoretical values of U-V in order to set up a scale of surface temperature. Author

N68-13349* National Aeronautics and Space Administration, Washington, D. C.

CONTRIBUTION TO THE THEORY OF THE PERTURBED KEPLER MOTION OF A MATERIAL POINT IN THE PRESENCE OF A SMALL TANGENTIAL FORCE [K TEORII VOZMUSHCHENNOGO KEPLEROVA DVIZHENIYA MATERIAL'NOY TOCHKI PRI NALICHII MALOY TANGENTSIAL'NOY SILY]

A. G. Ilyukhin Dec. 1967 11 p refs Transl. into ENGLISH from Ukr. Mat. Zh. (Kiev), v. 19, no. 3, 1967 p 21–28
(NASA-TT-F-11384) CFSTI: $3.00 CSCL 03C

The elliptical motion of a material point in the central gravitational field of the earth beyond the atmosphere is discussed. A spherically symmetrical gravitational field is postulated. An expression for the eccentricity is derived as an implicit function of the true-anomaly angle, together with four expressions defining the law of variation of the eccentricity under the effect of a small tangential force. An analysis of the perturbations of the parameter and the semimajor axis of the orbit is included. Author

N68-13351*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

RELATION BETWEEN REENTRY PLASMA KNOWLEDGE AND FLIGHT DATA

Paul W. Huber 1967 19 p refs Presented at the Conf. on Appl. of Plasma Studies to Reentry Vehicle Commun., Wright-Patterson AFB, Ohio, 3–5 Oct. 1967 Sponsored by AF Avionics Lab. and Ohio State Univ.
(NASA-TM-X-60771) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Data obtained in the Langley Research Center's project RAM and project FIRE reentry flight programs are reviewed, along with reentry data obtained in the Mercury and Gemini Manned Spacecraft programs. Comparisons of these data, and also some obtained in ground facilities, with various theoretical plasma analyses are described. Author

N68-13355* National Aeronautics and Space Administration, Washington, D. C.

REPRESENTATION OF TRAJECTORY AND VELOCITY COORDINATES FOR SPACE FLIGHT BY A GENERALIZED KEPLER APPROXIMATION AND CORRECTIONS IN THE ITERATION PROCEDURE [EINE DARSTELLUNG FUER BAHN- UND GESCHWINDIGKEITS-KOORDINATEN IN DER RAUMFAHRT DURCH EINE VERALLGEMEINERTE KEPLER-NAEHERUNG UND KORREKTUREN IM ITERATIONSVERFAHREN]

W. Bollermann Dec. 1967 43 p refs Transl. into ENGLISH from Deut. Luft- und Raumfahrt Research Rept. 66-08, Mar. 1966
(NASA-TT-F-11387) CFSTI: $3.00 CSCL 22C

A summation axiom from Keplerian motion of a space vehicle about all celestial participating bodies is established, making each initial-value problem accessible to perturbation calculus and being of high accuracy for limited time intervals. An extrapolation to auxiliary forces, in some standard cases, leads to closed approximate solutions for the n-body problem of space flight, including thrust and radiation pressure. An iteration process for limited time intervals is derived for calculating the correction function for the case of velocity-independent auxiliary forces. Author

N68-13356 Joint Publications Research Service, Washington, D. C.

THE "METEOR" SPACE SYSTEM

I. Vetlov 14 Dec. 1967 12 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 10, 1967 p 51–55
(JPRS-43715) CFSTI: $3.00

Selection of orbits for meteorological satellites is discussed in general and with regard to a system that was placed into circular near-polar orbits at altitudes of between 625 and 630 km. Analysis of satellite data recorded at ground stations on magnetic and photographic tapes is discussed. Television photographs taken from the Cosmos 144 satellite as well as cloud images with the Satellite's infrared camera are illustrated, and these and other meteorological data are analyzed. It is noted that data from the Cosmos 144 and Cosmos 156 are being used extensively by the Soviet hydrometeorological facility. M.W.R.

N68-13362* California Inst. of Tech., Pasadena.

A QUASAR MODEL BASED ON RELAXATION OSCILLATIONS IN SUPERMASSIVE STARS

William A. Fowler 15 Mar. 1965 36 p refs Presented at Belfer Sci. Forum of Yeshiva Univ., New York, 16 Nov. 1964
(Grant NGR-05-002-028; Contract Nonr-220(47))
(NASA-CR-91336) CFSTI: $3.00 CSCL 03B

The work described in this paper constitutes a return to the early point of view of Hoyle and Fowler that stars can meet the energy requirements in radio sources, specifically in the quasars. General relativity leads to dynamic instability in non-rotating massive stars but the first result is relaxation oscillations energized by hydrogen burning rather than catastrophic collapse at least for masses not exceeding 10^8 $M_\odot$. It is noted that the introduction of rotation raises this limit by several orders of magnitude. It is emphasized that the exotic forms of energy emission observed in the quasars can serve to damp the relaxation oscillations in such a way that stable pulsations result. It is thus suggested that quasars consist of pulsating supermassive stars, energized by nuclear reactions, with radio and optical emissions from extended surrounding regions which the star excites with ultraviolet radiation and relativistic particles. With the exhaustion of nuclear energy, gravitational energy may become available and the evolution of a quasar into an extended radio source becomes possible. Author

N68-13388* Wisconsin Univ., Madison.

[INVESTIGATIONS AND STUDIES OF ULTRAVIOLET STELLAR SPECTRA AND ASSOCIATED INSTRUMENTATION] Progress Report, Period Ending 30 Sep. 1967

A. D. Code, et al 15 Dec. 1967 22 p refs
(Grant NsG-618)
(NASA-CR-91378) CSCL 03B

An experimental package of seven photometers and two ion telescopes was launched with an Aerobee 150 sounding rocket to investigate the ultraviolet spectra of early type stellar atmospheres. The integration of the payload with the rocket's electronics and mechanics is presented and a discussion is given of the functioning of each instrument. The usable star signals received are tabulated, and data evaluation techniques are discussed. To change the wavelengths transmitted as different areas of the filter are used, wedge-shaped interference filters of the Fabry–Perot type were constructed. These provide for transmission bandpasses in the ultraviolet wavelength region of 1300 Å to 3000 Å. Summary information is given on experiments conducted to show that, in the ultraviolet, irregular surface refraction of lenses can broaden the field of view of a photometer considerably beyond its geometrical limits. Synchrotron radiation was calculated theoretically from both a classical relativistic and a quantum approach. Consideration is given to the feasibility of using such radiation from an electron storage ring for absolute calibration of photomultipliers in the vacuum ultraviolet. Calibration procedures are suggested. E.J.S.

N68-13409 Joint Publications Research Service, Washington, D. C.

ANALYSIS OF THE ROTATION AND ORIENTATION OF THE PROTON-2 SATELLITE [ANALIZ VRASHCHENIYA I ORIENTATSII SPUTNIKA PROTON-2]

V. V. Beletskiy, V. V. Golubkov, and I. G. Khatskevich 22 Dec. 1967 26 p refs Presented at the Intern. Astronautical Federation Congr., Belgrade, Sep. 1967
(JPRS-43822) CFSTI: $3.00

Rapid rotational spin and its effect on the orientation of a Proton type satellite are quantitatively analyzed. A model is assumed for which equations of motion are formulated to simulate the actual motion of the satellite about the center of mass. Experimental data from a three component magnetometer installed on Proton-2 are statistically analyzed and compared with the model. The theoretical results and experimental data show that the model assumed for the disturbed motion of the satellite describes quite well the basic characteristics of this motion. Sketches of the Proton satellite and various patterns of satellite motion are included. E.J.S.

N68-13413* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.

COMMENTS ON SEATON'S DISTANCE SCALE FOR PLANETARY NEBULAE

Charlotte Gordon [1966] 10 p refs
(NASA-TM-X-60775) CFSTI: $3.00 CSCL 03B

Many distance scales have been recently proposed for the planetary nebulae. They have been primarily deduced from such observational data as photographic magnitudes, flux in H_β or flux in H_α assuming a constant mass for the planetaries (Seaton assumes it only for planetaries with He II lines). However as the mean mass of the nebula differs in each study, a disagreement occurs between the different distance scales—Seaton's being the largest. (The value of Seaton's mean nebular mass is 0.6 M for high excitation nebulae). The purpose of this note is to rediscuss the way in which Seaton's distance scale was obtained. Author

N68-13486# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.

SPECULAR REFLECTION ON THE MOON

H. B. Liemohn Sep. 1967 20 p refs
(D1-82-0648; AD-661386)

An investigation of specular reflection of sunlight on the moon has revealed that relatively poor quality reflectors with areas of less than one square meter produce sufficient enhanced illumination to be detected in large telescopes on the earth. Consequently, small orientable reflectors on lunar satellites and landers would permit optical tracking of their trajectories. Such reflectors would also provide a feasible means of communicating information to the earth, and small natural reflectors on the surface may account for some bright flashes which have been sighted on the moon. Author (TAB)

N68-13567* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE INFLUENCE OF GROUND TRACK CONSTRAINTS UPON ORBIT REQUIREMENTS FOR SUN SYNCHRONOUS SATELLITES

Daniel L. Endres Dec. 1967 42 p refs
(NASA-TM-X-63066; X-734-67-598) CFSTI: $3.00 CSCL 22C

The ground track is analyzed of a satellite which has nearly an integral number of orbits in one sidereal day. Analytical expressions are derived for an oblate earth which show: (1) the semi-major axis, period and inclination as a function of ground track displacement rate and nearest integral number of orbits per day; and (2) the smallest percentage of swath overlap for orbits of various eccentricities and altitudes. Computer runs are used to study orbit perturbations due to a triaxial earth, gravitational fields of the sun and moon, atmospheric drag and solar radiation pressure. Additional constraints resulting from a sun illumination angle have been included to show the fraction of the orbit spent in shadow as a function of orbit semi-major axis. Author

N68-13610*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE EFFECTS OF THE GALILEAN MOONS ON JUPITER FLYBY TRAJECTORIES

Bernard Kaufman Sep. 1967 75 p refs
(NASA-TM-X-63060; X-551-67-497) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The perturbative effects of the four largest moons of Jupiter on a spacecraft that passes close to Jupiter are investigated using a total of twenty different encounter trajectories with the planet. An accurate model for the moons is utilized in the equations of motion which are numerically integrated over the time that the probe spends within Jupiter's sphere of influence. It is shown that the perturbations caused by the moons do have effects on the post encounter heliocentric trajectories which are large enough to make necessary the inclusion of the moons in any detailed study to be undertaken. On the other hand, actual mission objectives such as the time to 10 astronomical units seem to be little affected by the presence of the moons. A valuable by-product of this study has been the programming of an accurate ephemeris for the Galilean moons which has not previously been available in this country as far as the author has been able to determine. Author

N68-13629*# Florida Univ., Gainesville. Dept. of Physics and Astronomy.

PHOTOELECTRIC PHOTOMETRY OF HD 116994

Kwan-yu Chen (Cerro Tololo Inter-American Obs.) [1967] 16 p refs Sponsored by NSF
(Grant NsG-542)
(NASA-CR-91506) CFSTI: HC $3.00/MF $0.65 CSCL 03A

From observation on three nights, the period of HD 116994 was found to be 0.1022623 day. Harmonic analyses were made of the light curves and color curves. The observed mean color indices are: B-V = +0.393 and U-B = +0.137. The intrinsic color indices are found to be: $(B-V)_0$ = +0.270 and $(U-B)_0$ = +0.048. Pulsation theory yields $\rho = 0.103\ \rho_\odot$, and $R = 1.4\ R_\odot$. The absolute visual magnitude is estimated to be +2.0, which seems realistic in view of the interstellar reddening and the predictions of the pulsation theory. Author

N68-13660*# Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

CRATER EFFECTS ON FULL MOON DIRECTIONALITY OF LUNAR THERMAL RADIATION

J. P. Doty Dec. 1967 39 p refs
(Contract NAS8-20166)
(NASA-CR-61413; R-252) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A geometrical model of the lunar surface has been used to explain the directionality of the lunar thermal radiation from the full moon. From this model and measured data, an estimate of the crater density in certain locales has been calculated. The model assumes a lunar surface with hemispherical craters. A perturbation on the radiation intensity, caused by these craters, is added to Lambert's radiation cosine law. The resulting equation agrees very well with experimental data. With the resulting equation and a general crater distribution of $N = N_0 r^{-3}$, the local crater density is calculated. Author

N68-13661 Polish Academy of Sciences, Warsaw.
LATITUDE VARIATIONS GRAVIMETRY
1967 147 p refs In POLISH and ENGLISH Presented at Seminar held at Borowiec, 5–6 Oct. 1966 *Its* Mater. and Paper No.6

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7. CHANGES OF THE POLE DETERMINED ON THE GROUND OF OBSERVATIONAL DATA OF THE INTERNATIONAL TIME AND LATITUDE SERVICE STATIONS FOR THE PERIOD 1962–1964 M. Dukwicz-Latka p 51–69 refs (See N68-13668 04-30)

8. ON THE CHECKING OF INSTRUMENTAL ERRORS OF A ZENITH TELESCOPE J. Bieniewski p 71–75 (See N68-13669 04-14)

9. THE PROGRAMME FOR COMPUTING MEAN AND APPARENT STAR PEACES IN GIER–ALGOL 3 CODE S. Domaradzki p 77–86 refs (See N68-13670 04-30)

10. OBSERVATIONS OF A BRIGHT TALCOTT PAIR B. Bieniewski p 88–92 (See N68-13671 04-30)

11. INSTRUMENTAL ERRORS OF THE ZENITH TELESCOPE IN JOZEFOSLAW I. Gajderowicz p 93–113 refs (See N68-13672 04-14)

12. A COMPARISON OF METHODS OF DETERMINING THE VALUE OF THE TURN OF THE MICROMETER SCREW K. Schilling p 115–123 refs (See N68-13673 04-14)

13. A COMPARISON OF YALE ZONE ASTROGRAPHIC CATALOGUE WITH THE CATALOGUE OF AGK2 REFERENCE STARS OF +50–55° DECLINATIONS W. Jaks p 125–130 refs (See N68-13674 04-30)

N68-13662 Polish Academy of Sciences, Warsaw.
REPORT ON ACTIVITIES OF THE LATITUDE SERVICE AT THE WARSAW POLYTECHNIC'S ASTRONOMICAL-GEODETIC OBSERVATORY JOYEFOSLAW [Z DZIALALNOSCI SLUZBY SZEROKOSCI W OBSERWATORIUM ASTRONOMICZNO-GEODEZYJNYM POLITECHNIKI WARSZAWSKIEJ W JOSEFOSLOWIU]
Barbara Kolaczek *In its* Latitude Variations Gravimetry 1967 p 9–14 refs (See N68-13661 04-30)

Continuing observations are reported, and the curve of latitude variations and normal points comprising the observation results are graphed. Instrumental constants were investigated and evaluated. A new program of observations was begun that is based on a pair of star groups, each of which contains several stars. N.E.N.

N68-13663 Polish Academy of Sciences, Warsaw.
LATITUDE WORKS AT ASTRONOMICAL-GEODETIC OBSERVATORY OF THE TECHNICAL UNIVERSITY BRATISLAVA
Otokar Macko *In its* Latitude Variations Gravimetry 1967 p 15–20 refs (See N68-13661 04-30)

The emphasis in recent observatory activities was placed on problems concerning instrument errors, instrument orientation, and the construction of an automatic recording device to be used with the micrometer. The problem incurred by the systematic difference in values of latitude determined by observations of one Talcott pair of stars made with two positions of the micrometer is discussed. It is concluded that the main disadvantages of an increased number of pointings of the Talcott pairs are removed. N.E.N.

N68-13664 Polish Academy of Sciences, Warsaw.
THE ACTIVITIES OF THE LATITUDE BRANCH OF THE ASTRONOMICAL LATITUDE STATION IN BOROWIEC [DZIALANOSC PRACOWNI SZEROKOSCI W ASTRONOMICZNEJ STACJI SZEROKOSCIOWEJ W BOROWCU]
Waldemar Jaks *In its* Latitude Variations Gravimetry 1967 p 22–25 refs (See N68-13661 04-30)

The primary observations reported were for determining the latitude variations. Two programs of observing Talcott pairs were followed: one with four groups each containing 8 pairs, and one with 12 groups of pairs. The first program was considered to yeild more reliable linkages between star groups and to have less error. Besides the latitude variations, the mean latitude and corrections to the declinations of star groups were obtained. A series of stars in the zenith zone was chosen for the evaluation of a turn in the micrometer screw. N.E.N.

N68-13665 Polish Academy of Sciences, Warsaw.
ON THE DETERMINATION OF VARIATIONS OF LATITUDE BY OBSERVATIONS OF PAIRS OF STARS GROUPS [WYZNACZANIE ZMIAN SZEROKOSCI GEOGRAFICZNEJ Z OBSERWACJI HORREBOWTALCOTTA]
Barbara Kolaczek and Jan Bieniewski *In its* Latitude Variations Gravimetry 1967 p 31–38 refs (See N68-13661 04-30)

A program to eliminate the influence of the errors of declination is described, based on using a larger number of observed stars. The substitution of two groups of stars in place of the usual Talcott pairs increases considerably the number of stars observed during one night. Observations are made of 39 pairs of star groups with 574 stars from the Yale catalog. From March 1965 to September 1966, 2490 observations were taken on 58 nights. The curve of latitude variation was obtained. The mean latitude differs by +0".14 from that based on observations made according to the standard program (12 groups of stars). The results indicate declination errors of the order of several tenths of a second. Author

N68-13666 Polish Academy of Sciences, Warsaw.
THE NEW OBSERVING PROGRAMME FOR THE PARALLEL OF IRKUTSK AND BOROWIEC [NOWY PROGRAM OBSERWACJI SZEROKOSCIOWYCH DLA ROWNOLEZNIKA IRKUCK-BOROWIEC]
Waldemar Jaks *In its* Latitude Variations Gravimetry 1967 p 39–46 (See N68-13661 04-30)

Details of the new program are given, and the main feature is considered to the reduction of observation time for one group from 2 hours to 1.5 hours. The period of observation period of the main groups is thus lengthened to 50 years. Tabulated data are included. Author

N68-13667 Polish Academy of Sciences, Warsaw.
A MODIFICATION OF TALCOTT'S METHOD FOR DETERMINING THE VARIATIONS OF LATITUDE (AFTER J. C. BHATTACHARJI) [MODYFIKACJA METODY TALCOTTA OBSERWACJI ZMIAN SZEROKOSCI WEDLUG J. C. BHATTACHARJI]

Kazimierz Schilling *In its* Latitude Variations Gravimetry 1967 p 47–49 ref (See N68-13661 04-30)

In the modified method, it is proposed to observe two stars, alternatively north and south of the zenith, each star being observed in four azimuths before, and in four after the meridian passage. A complete set of observations is composed of 8 pairs of measurements in equal though varying zenith distances. The condition $h_s=h_n$ can be maintained by means of a simple adjustment of the time table. No alterations in the star list are needed, and a precise determination of the turn of the micrometer screw can be eliminated. Twelve pairs of stars are necessary for the application of the chain method of reduction for a yearly series of observations. These pairs can easily be formed with the KF4 stars. Author

N68-13668 Polish Academy of Sciences, Warsaw.
CHANGES OF THE POLE DETERMINED ON THE GROUND OF OBSERVATIONAL DATA OF THE INTERNATIONAL TIME AND LATITUDE SERVICE STATIONS FOR THE PERIOD 1962–1964 [OPRACOWANIE PRZEBIEGU ZMIAN BIEGUNA NA PODSTAWIE MATERIALU OBSERWACYJNEGO STACJI MIEDZYNARODOWYCH SLUZB CZASU I SZEROKOSCI W OKRESIE LAT 1962–1964]
Magdalena Dukwicz-Latka *In its* Latitude Variations Gravimetry 1967 p 51–69 refs (See N68-13661 04-30)

For the determination of the instantaneous coordinates of the pole, the data from observations of time and latitude of the nine stations were used. The preliminary coordinates of the pole were first calculated, which enabled the examination of the deflection curve for individual stations. In each curve the periodic and the irregular components were differentiated. The peroidic component corresponds to the Kimura term for latitude observations and to the term for time observations. The irregular term characterizes the accuracy of the determination of ϕ and T at the particular stations and was used for evaluating the weights of observations. In the next step, the ultimate coordinates were calculated using the weights and taking into account the terms for the latitude and time observations. The coordinates obtained were compared with the results of the BIH for the same period. Author

N68-13670 Polish Academy of Sciences, Warsaw.
THE PROGRAMME FOR COMPUTING MEAN AND APPARENT STAR PLACES IN GIER–ALGOL 3 CODE [PROGRAM OBLICZANIA DEKLINACJI POZORNYCH PAR GWIAZD DO REDUKCJI OBSERWACJI SLUZBY SZEROKOSCI W BOROWCU I JOZEFOSLAWIU, DLA ELEKTRONICZNEJ MASZYNY CYFROWEJ W JEZYKU GIER–ALGOL 3]
Stanislaw Domaradzki *In its* Latitude Variations Gravimetry 1967 p 77–88 refs (See N68-13661 04-30)

The first program serves to reduce the mean star positions from 1950.0 to date. The input tape contains the catalog data of right ascension, declination, and proper motion of stars for the initial epoch. The computer calculates for each pair the mean values of Besselian star constants, proper motion, and mean declination. The second program computes the apparent declinations for the moment of observation and the Besselian day numbers. New formulas are used for nutation, preserving all terms with coefficients not smaller than 0".0002. Day numbers are computed from the perturbed orbital motion of the Earth, referred to the barycenter of the solar system. The star constants are computed from the true longitude of the Sun. This simplification leads to errors in declinations of the order of 0".2. To obtain the accuracy of 0".1 in apparent declination, a variant of the program was prepared taking into account the barycenter of the solar system. Rectangular coordinates of Jupiter, Saturn, Uranus, and Neptune are also needed in this case. Author

N68-13671 Polish Academy of Sciences, Warsaw.
OBSERVATIONS OF A BRIGHT TALCOTT PAIR [WYNIKI ROCZNEGO CYKLU OBSERWACJI PARY JASNYCH GWIAZD METODA HORREBOW-TALCOTTA W OBSERWATORIUM W JOZEFOSLAWIU]
Jan Bieniewski *In its* Latitude Variations Gravimetry 1967 p 89–92 (See N68-13661 04-30)

Observational data indicate that, although the pair's parameters are not favorable, the precision reached equals that of zenith star observations. There is, moreover, a wider choice of suitable stars for a pair of bright stars than for zenith stars. Author

N68-13674 Polish Academy of Sciences, Warsaw.
A COMPARISON OF YALE ZONE ASTROGRAPHIC CATALOGUE WITH THE CATALOGUE OF AGK2 REFERENCE STARS OF +50–55° DECLINATIONS [POROWNANIE STREFOWEGO KATALOGU FOTOGRAFICZNEGO YALE Z KATALOGIEM GWIAZD OPOROWYCH AGK DLA STREFY DEKLINACJI +50° DO +55°]
Waldemar Jaks *In its* Latitude Variations Gravimetry 1967 p 125–130 refs (See N68-13661 04-30)

The comparison was made to determine the systematic errors of the Yale catalog. The results indicate a dependence between the systematic errors of both catalogs. The existence of systematic errors peculiar to astrographic observations is confirmed. Author

N68-13750* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
POTENTIAL LUNAR LANDING AREAS FOR EARLY APOLLO MISSIONS
James H. Sasser and Andrew W. Patteson Dec. 1967 43 p
(NASA-TM-X-58014) CFSTI: $3.00 CSCL 22A

One of the primary functions of the Lunar Orbiter Program was to provide high-resolution photographic coverage of potential Apollo landing sites. The photographs were screened by using Apollo lunar landing criteria to exclude rough areas and to select the smoothest sites for further study. On this basis, eight potential landing areas have been located and are undergoing detailed analysis. Author

N68-13760* Boeing Co., Seattle, Wash.
LUNAR ORBITER 5: POSTMISSION PHOTO SUPPORTING DATA
14 Nov. 1967 541 p
(Contract NAS1-3800)
(NASA-CR-66517; D2-100755-7) CFSTI: $3.00 CSCL 22A

In this volume, the photo supporting data for each of the Lunar Orbiter 5 photos are described and tabulated based on post-mission analyses of orbit, trajectory, and spacecraft performance factors. General concepts and methods employed to derive the photo supporting data and other parameters for the Mission 5 photos are briefly discussed. Defined are the parameters contained in the photo evaluation computer program (EVAL), the version of the ephemeris data used, and the sources of input data required for computation of the photographic supporting data. Spacecraft and planetary constants and EVAL input decks are listed, and orbit determinations and lunar harmonics are summarized. The photographic evaluation data output covers camera state vector at photo time and properties of all the photographs that were taken. K.W.

N68-13763*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
STABILITY CRITERIA FOR THE OAO COARSE POINTING MODE, PART 1 Final Report

Samuel E. Moskowitz Nov. 1967 44 p refs
(Contract NAS2-4063)
(NASA-CR-73165; Doc.-67SD4363, Rev. 1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An investigation was conducted to find criteria that ensure a stable response of OAO vehicle to an impulsive disturbance. A physical description of the closed loop multidimensional feedback system is given, an asymptotically stable response is defined, and similarities within distinct groups of two tracker cases are discussed. Basic equations which simulate the dynamics in the elements are presented. They include sufficient generality to accommodate all nonlinear mathematical models. Stability for the linear model and criterion represented by closed region in gimbal angle space are discussed. The nonlinear model that includes only motor saturation is considered. Differential equations are examined to reveal local behavior near linearity and a Liapunov technique is used to shed light on the question of globality. Criteria are sought in terms of inequalities. Author

N68-13770*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A NUMERICAL SOLUTION OF KEPLER'S PROBLEM IN UNIVERSAL VARIABLES
R. C. Blanchard and P. E. Zadunaisky Dec. 1967 32 p refs
(NASA-TM-X-63072; X-643-67-627) CFSTI: HC $3.00/MF $0.65 CSCL 03C

A numerical approach to solving Kepler's universal transcendental equation is presented. A universal first approximation to the solution is obtained by solving a cubic equation which resembles the parabolic conic equation. A quadratic Newton–Raphson iteration technique is discussed. Results indicate that this technique gives a solution to 8-digit accuracy for most practical cases by only a few repeated iterations. Author

N68-13809* Kansas State Univ., Manhattan. Physics Dept.
INFRARED LABORATORY STUDIES OF SYNTHETIC PLANETARY ATMOSPHERES Semiannual Status Report, 1 Jun.–30 Nov. 1967
Dudley Williams 11 Dec. 1967 36 p refs
(Grant NGR-17-001-026)
(NASA-CR-91528; SASR-11) CFSTI: $3.00 CSCL 03B

The overlapping absorption bands of CO and N_2O in the 2200 cm^{-1} region were examined to determine the need for introducing an effective pressure in Burch's Law when studying planetary atmospheres. The test results indicate that no modification is needed. The collision cross-section ratio for self-broadening to that for foreign gas broadening has been measured for 21 rotational lines in the R-branch of the CO fundamental. With N_2 as the broadener, the ratio has the same value for all lines since the mass of CO and N_2 molecules are equal. For broadeners with masses less than that of CO, the ratio is greater for lines near the band center than for lines in the band wing. The reverse is true in the case of broadeners with masses greater than that of CO. The experimental results are interpreted in terms of a phenomenological theory which distinguishes between adiabatic collisions and nonadiabatic collisions involving CO molecules in the ground state. In addition, the total band absorptance of the CO fundamental has been measured for a large range of absorber thicknesses and effective pressures, and the strengths and half-widths of CO lines at reduced temperatures were calculated from studies in the so-called linear and square root regions. E.J.S.

N68-13844 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE NECESSARY AND SUFFICIENT CONDITIONS OF A FUNCTIONAL EXTREMUM IN THE PROBLEM OF OPTIMUM FLIGHT OF A VEHICLE WITH A LOW-THRUST DRIVE [O NEOBKHODINYKH I DOSTATOCHNYKH YSLOVIYAKH EKSTREMUMA FUNKTSIONALA V ZADACHE OPTIMAL'NOGO PERELETA LETATEL'NOGO APPARATA S DVIGATELEM MALOY TYAGI]
L. A. Lebedev and S. A. Sakovskiy *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 25–33 refs (See N68-13841 04-28)

An analytical solution is presented to the problem of determining a routine for the variation of the acceleration control vector in the flight of a low-thrust spacecraft between two points. It is assumed that the optimal flight takes place within the gravitational field of two bodies, the Sun and a planet, and that the flight time is given. To simplify the calculation, it is assumed: (1) The trajectories of the spacecraft and the planet are coplanar. (2) The planet moves in a circular orbit. Equations of motion are derived, and boundary conditions are established. The methods of classical calculus of variations are used. Author

N68-13862# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A POROSITY-POLARIZATION RELATIONSHIP APPLICABLE TO THE LUNAR SURFACE
W. G. Egan and E. A. Nowatzki Dec. 1967 16 p refs Submitted for publication
(RM-390)

Because basalts have been considered as a possible constituent of the lunar surface, a <38μ basalt powder was used in this investigation of the effect of surface porosity on the polarimetric properties of a loosely compacted particulate material. The effect of three surface porosities between 26% and 55% on surface roughness (defined in terms of a distribution of slope lengths), and in turn the effect on the spectral polarimetric curves in B(0.48μ), G(0.54μ) and I(1.0μ) light were investigated. The porosity–polarization relationship is best shown in I where the highest polarization at a 120 degree phase angle (11.0%) occurs with the highest albedo (0.26) and lowest surface porosity (26%); the highest surface porosity (55%) and lowest albedo (0.21) occurs with the lowest polarization at a 120 degree phase angle (5.4%). Author

N68-13882 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
SOME PROBLEMS RELATING TO MARS AND ITS EXPLORATION
Oct. 1967 93 p refs
(DAC-60841)

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1. MARTIAN SURFACE CHARACTERISTICS AND REMOTE SENSING FOR BIOLOGICAL CONSIDERATIONS C. E. Melton, W. B. Milton, and F. F. Fish, Jr. p 1–26 refs (See N68-13883 04-30)

2. CRITIQUE OF POSSIBLE EXPERIMENTS FOR VOYAGER F. F. Fish, Jr., J. A. Ryan, H. G. Gross, and N. R. Mukherjee p 27–36 (See N68-13884 04-30)

3. MEASUREMENT OF ATMOSPHERIC PROPERTIES FROM ATTENUATION OF SOLAR UV AND X-RAY RADIATION H. G. Gross and V. A. Sirounian p 37–59 refs (See N68-13885 04-30)

4. POSSIBLE EXISTENCE OF AN H_2O LIQUID PHASE ON MARS: AND THE ALUMINUM OXIDE HYGROMETER N. R. Mukherjee and J. J. Grossman p 61–93 refs (See N68-13886 04-30)

N68-13883 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
MARTIAN SURFACE CHARACTERISTICS AND REMOTE SENSING FOR BIOLOGICAL CONSIDERATIONS

C. E. Melton, W. B. Milton, and F. F. Fish, Jr. *In its* Some Probl. Relating to Mars and Its Exploration Oct. 1967 p 1–26 refs (See N68-13882 04-30)

Consideration is given to processes acting on the surface, soil characteristics from observations, soil models, detection of organic materials, and detection of conditions favorable to the presence of life in determining the feasibility of direct detection of life from an orbiter. Also given consideration are such areas as chemical weathering, water erosion and deposition, frost action, grain size, porosity, infrared absorption bands, and detection of mositure. It is concluded that the direct detection of life from an orbiter appears to be of low probability because it may not be possible to detect life forms from orbital altitudes, and no remote sensing method is completely diagnostic for organic material. C.T.C.

N68-13884 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

CRITIQUE OF POSSIBLE EXPERIMENTS FOR VOYAGER

F. F. Fish, Jr., J. A. Ryan, H. G. Gross, and N. R. Mukherjee *In its* Some Probl. Relating to Mars and Its Exploration Oct. 1967 p 27–36 (See N68-13882 04-30)

An evaluation is presented of the "Pre-phase B. 1973 Voyager Capsule Experiments Data Book", and some specific comments on the experiments are given. Priorities to the experiments are assigned, and several additional experiments of high priority are appended. A discussion of the basic reasons for assigning the priorities is included. C.T.C.

N68-13885 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

MEASUREMENT OF ATMOSPHERIC PROPERTIES FROM ATTENUATION OF SOLAR UV AND X-RAY RADIATION

H. G. Gross and V. A. Sirounian *In its* Some Probl. Relating to Mars and Its Exploration Oct. 1967 p 37–59 refs (See N68-13882 04-30)

Instrumentation and experimental requirements are discussed for a Mars probe to determine the atmospheric properties from solar ultraviolet and X-ray radiation measurements. Principal and secondary objectives of the experiments are listed, and previously derived applications are extended to the requirements and constraints of Voyager missions. Included are discussions of a molecular and aerosol scattering study, and an experiment for entry and surface landing laboratory measurements. C.T.C.

N68-13886 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

POSSIBLE EXISTENCE OF AN H_2O LIQUID PHASE ON MARS: AND THE ALUMINUM OXIDE HYGROMETER

N. R. Mukherjee and J. J. Grossman *In its* Some Probl. Relating to Mars and Its Exploration Oct. 1967 p 61–93 refs (See N68-13882 04-30)

All the circumstances under which liquid water may exist even for a brief period during summer are examined, and the use of an aluminum oxide hygrometer for H_2O detection is discussed. The presence of water was explored for the following cases: (1) freezing point depression, (2) surface condensation, (3) condensation at active spots, (4) capillary evaporation and condensation, (5) melting of water permafrost and agglomerated ice crystals, and (6) upflow of subterranean water. It was found that for the first three cases, the presence of liquid water is improbable. For case four it is possible provided certain special capillaries and conditions exist at the Martian surface and subsurface. Such special capillaries and conditions in the soil are not considered likely throughout the surface and subsurface; therefore, the presence of liquid water is doubtful except possibly in rare locations. For case five formation of water is also unlikely. For case six it is possible for liquid water to exist for a brief period each day during summer, provided certain conditions are fulfilled for the upward flow of subterranean water. The feasibility of using an aluminum oxide hygrometer is discussed, and areas of further study for its use on a Voyager mission are outlined. C.T.C.

N68-13889*# American Science and Engineering, Inc., Cambridge, Mass.

X-RAY ASTRONOMY EXPERIMENTS (S017 AND S069): APOLLO APPLICATIONS PROGRAM (AAP) FLIGHT PHASE 1 Final Report, 1 Jun.–1 Nov. 1967

30 Nov. 1967 259 p refs

(Contract NAS9-7201)

(NASA-CR-65888; ASE-1758) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The scope of Phase I was to conduct a study, evaluation, and reappraisal of the existing S017 flight hardware for incorporation into the S069 experiment which was assigned to a new carrier on an AAP mission. In particular, the Multiple Docking Adapter (MDA) for Mission AAP-2 was given prime consideration. The performance requirements and system concept for the S069 scientific instrument were established for a state-of-the-art equipment design. This will satisfy the scientific objectives for an experiment designed to contribute significantly to the field of X-ray astronomy. In addition, the engineering problems and reliability requirements associated with the integration of the scientific instrument into the MDA experiment carrier were evaluated and the proposed technical solutions are discussed in this report. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-12958*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

STRUCTURAL DEFORMATIONS IN THE SATURN INSTRUMENT UNIT

Larry A. Kiefling 20 Nov. 1967 23 p refs

(NASA-TM-X-53673) CFSTI: HC $3.00/MF $0.65 CSCL 22D

During the Saturn V dynamic test, local deformations of significant amplitude were measured at the flight sensor locations in the instrument unit. These local deformations were previously thought to be negligible. The cause is identified as a radial force component at the joint of the LM adapter cone and the instrument unit cylindrical shell due to the axial resultants from the bending moment. The deformation patterns for a shell analysis of the structure are shown. The local deformation is found to be proportional to the bending moment only and the proportionality constant is determined for three instrument locations. Typical amplitudes for Saturn V modes and a selection of points from the Saturn IB dynamic test program are presented. Author

N68-13137 Royal Aircraft Establishment, Farnborough (England).

TABLE OF THE EARTH SATELLITES LAUNCHED IN 1957–66

Eileen Quinn and D. G. King-Hele Feb. 1967 131 p refs

(RAE-TR-67039)

All known artificial satellites launched before 1 January 1967 are listed chronologically. Lifetimes, weights, dimensions, and orbital details are given for instrumented satellites and their

final-stage rockets. Other fragments from satellites are listed without these details. The methods used in compiling the Table are described. Author

N68-13281# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
L.A.S.-I SPACECRAFT AND EXPERIMENTAL PACKAGE INTEGRATION
J. J. Weaver Paris ESRO Aug. 1966 20 p
(ESRO-TM(P)-69) CFSTI: HC $3.00/MF $0.65

An initial indication is given of the relative time scales, major integration and test requirements, and a definition of the suggested various models of spacecraft and experimental package of the Large Astronomical Satellite. It is evident that, to ensure smooth progress of development of the satellite, the various models of the experimental package at different stages of development must be carefully phased into the time scale of the spacecraft program. Author (ESRO)

N68-13283# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
LAUNCHER SETTINGS VERSUS JACK SETTINGS FOR AEROBEE-150 LAUNCHERS—LAUNCH COMPLEX 35 WHITE SANDS MISSILE RANGE, NEW MEXICO
Gordon L. Dunaway and Mary Ann B. Seagraves Aug. 1967 307 p
(ECOM-5152, Sup. B; AD-661643)

Launcher settings versus jack settings for Aerobee-150 launchers are listed for launch complex 35 at White Sands Missile Range, New Mexico. TAB

N68-13398# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
WEIGHT AND INERTIA ESTIMATE FOR AN INTEGRATED VERSION OF THE SMALL ASTRONOMICAL SATELLITE (THOR-DELTA LAUNCH VEHICLE)
D. C. Clayton Paris ESRO May 1965 8 p
(ESRO-TM(P)-60) CFSTI: HC $3.00/MF $0.65

It is proposed for the Small Astronomical Satellite to have two telescopes and be controlled via one star tracking platform. With the estimated weights of the currently proposed systems (structure, attitude control, scientific experiment, power supply, communication and data handling), it seems unlikely that the satellite, in its two (45 cm) mirror form, can be built to the original target weight of 450 kg. With a contingency allowance for weight growth it appears that a more reasonable figure of the overall weight would be 480 kg. Overall inertia would be of the the order of 160 kg m^2. Author (ESRO)

N68-13400# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
ORIENTATION OF THE L.A.S. SOLAR PADDLES
J. G. Fielding Paris ESRO Jan. 1966 9 p
(ESRO-TM(P)-65) CFSTI: HC $3.00/MF $0.65

A configuration for orienting the Large Astronomical Satellite solar paddles is suggested and discussed. The orientation of the panels may be achieved in three ways: (1) continuous operation with a servo loop from a sun sensor; (2) operation by command or by program, of a servo loop from a sun sensor, and (3) operation by command or by program, or fixed movements at regular intervals. The advantages and the disadvantages of these methods are noted. It is concluded that orienting the solar array would provide a considerable saving in space and weight. A more detailed study of the mechanical complexity, of the effect of the control system and of the reliability is necessary in order to determine whether the configuration is practicable or not. Author (ESRO)

N68-13403# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
FIRST ESTIMATION OF POWER REQUIRED FOR THE LARGE ASTRONOMICAL SATELLITE
R. Somoza Paris ESRO Nov. 1966 13 p
(ESRO-TM(P)-74) CFSTI: HC $3.00/MF $0.65

The overall power requirements of the components of the Large Astronomical Satellite are considered, together with the losses occurring in power generating, storing, and converting equipment. The power requirements for different modes of operation are then studied, based on reasonable hypotheses about the equipment which the satellite will probably contain. The probable power consuming items are listed and the corresponding power requirements estimated. Finally, the total power consumption is calculated for the different operating modes, obtaining the power requirements for a typical orbit and the corresponding projected area of solar paddles. Author (ESRO)

N68-13407# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
WEIGHT AND INERTIA ESTIMATE FOR THE LARGE ASTRONOMICAL SATELLITE
D. C. Clayton Paris ESRO May 1965 11 p
(ESRO-TM(P)-59) CFSTI: HC $3.00/MF $0.65

The current configuration considered for the Large Astronomical Satellite has a central body, capable of accepting an experimental package of approximately 2.8 m×1 m dia., flanked by structural members to which are attached the solar cell arrays. The central body is capable of rotating between these members, to which it is connected by short shafts. In the configuration both members contain star tracking platforms and in the alternative arrangement only one star tracking platform is used. It is this latter configuration which is considered in the accompanying weight estimate (with no star sensor redundancy allowed), to achieve the desired target weight of 800 kg. If two star tracking platforms are used, then the all-up weight will be of the order of 840 kg. This configuration will give 100% redundancy of required numbers of star sensors. In both cases a reasonable contingency allowance for weight growth is included in the total weight. Overall inertia would be of the order of 600 kg mE_2B. Author (ESRO)

N68-13481* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
APOLLO/SATURN IB FLIGHT SAFETY PLAN, VEHICLE AS-201
17 Jan. 1966 19 p
(NASA-TM-X-60783; K-IB-02-13) CFSTI: $3.00 CSCL 22B

This flight safety plan presents flight safety requirements, restrictions, and instrumentation necessary for each launch. The plan defines flight safety responsibilities of the Air Force Eastern Test Range and Kennedy Space Center. The requirements for flight termination and propellant dispersion are described, and the restrictions and instrumentation applicable for each Apollo/Saturn IB flight are listed. This plan is applicable during the launch countdown and throughout powered flight of the vehicle. Author

N68-13482*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
APOLLO/SATURN V FLIGHT SAFETY PLAN, VEHICLE AS-501
1 Sep. 1967 20 p
(NASA-TM-X-60782; K-V-05-13/1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Flight safety requirements, restrictions, and instrumentation necessary for each launch are presented. The plan defines flight safety responsibilities of the Air Force Eastern Test Range (AFETR) and Kennedy Space Center (KSC). The requirements for flight termination and propellant dispersion are described, and the restrictions and instrumentation applicable for each Apollo/Saturn V flight are listed. This plan is applicable during the launch countdown and powered flight of the vehicle up to orbit insertion. Author

N68-13581# New Mexico State Univ., University Park.
UNGUIDED ROCKET BALLISTICS METEOROLOGY CONFERENCE
Elmer J. Trawle Ft. Monmouth, N. J. Army Electron. Command 1967 657 p refs Conf. held in University Park, N. Mex., 31 Oct.–2 Nov. 1967
(AD-661631)

Conference papers are presented on aerodynamics of rockets and unguided launch vehicles, atmospheric turbulence and wind data, and computational processes. For individual titles see N68-13581–N68-13605. N.E.N.

N68-13583# New Mexico State Univ., University Park.
DETERMINATION OF THE SOUNDING ROCKET CONFIGURATION
George R. Conrad *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 41–64 refs (See N68-13581 04-31)

Presented is a discussion of inherent problems associated with the design of a sounding rocket which focuses on factors influencing the selection of an existing vehicle design for a new application (i.e., determination of a configuration). It is assumed that the sounding rocket is characterized as a ballistic vehicle, i.e., the flight path is controlled only by launcher aim, and the flight paths are to be of the near-vertical type. Examined are design processes involved in (1) vehicle sizing; (2) configuration selection; (3) detail design; and (4) testing. It is concluded that although the determination of the sounding rocket configuration is a less risky procedure today because of powerful flight simulation methods now available, other methods have indicated to the vehicle engineer a host of anomalies, particularly in vehicle dynamics, which challenge the capabilities of flight simulation. It is further surmised that these trends assure a need for continuing an intensified effort on the part of the rocket vehicle designer to be thorough and resourceful in evolving new sounding rocket vehicle designs; and it is also incumbent upon the sounding rocket user to recognize these vehicles for what they are, a fairly complex flying machine, not necessarily a simple, inexpensive item of ordnance. S.C.W.

N68-13584# Atlantic Research Corp., Costa Mesa, Calif. Missile Systems Div.
FIN/SPIN STABILIZATION OF UNGUIDED LAUNCH VEHICLES
A. T. Marriott and R. R. Brooks *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 65–94 (See N68-13581 04-31)

The design and development of system concepts which utilize an unguided boost phase and a partially guided reentry phase during long range overland flights require that special considerations be given to accuracy and safety. Discussed in this paper are design techniques utilized during the early design phase of an improved Athena vehicle to insure system accuracy and safety. These include the aerodynamic/spin stabilization techniques used to provide the optimum dispersion/stability characteristics during boost within the constraints established by other design considerations. Also included are the spin stabilization techniques used during the exoatmospheric portion of flight. The effect of spin on stage separation dynamics is also discussed. Author

N68-13585# Space Data Corp., Phoenix, Ariz.
NEW LOW COST METEOROLOGICAL ROCKET SYSTEM FOR TEMPERATURE AND WIND MEASUREMENT IN THE 75,000 TO 200,000 FEET ALTITUDE REGION
Bruce Bollermann and Robert L. Walker *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 95–132 refs (See N68-13581 04-31)

An instrumented dart system, which can be used as the upper stage of the Loki Dart meteorological rocket vehicle, has been designed to measure vertical profiles of temperature and winds between 75,000 feet and 200,000 feet altitudes. The components of the instrumented dart include the dart assembly, time delay and payload expulsion system, telemetry system, temperature sensor, and parachute. The telemetry system is designed to be compatible with the Rawin Set AN/GMD-1B and associated equipment. Flight tests of the system demonstrated the feasibility of the system for measurement of upper atmosphere winds and temperatures. An error analysis for temperature and wind measurements indicates that appreciable improvements can be obtained by reducing the descent rate of the parachute-sonde system. Author

N68-13586# Thiokol Chemical Corp., Ogden, Utah. Astro-Met Div.
SOUNDING ROCKET PERFORMANCE APPROXIMATIONS
Wolfgang Schaechter *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 133–151 refs (See N68-13581 04-31)

A number of empirically derived approximations were developed that accurately describe the variation, with launch elevation angle, of several important sounding rocket performance parameters. Performance parameters considered were apogee altitude, apogee time, the ratio of impact range to apogee altitude, impact range, impact time, and range derivatives. The relationships for these performance parameters gave answers which were within 1.0% of the values obtained from a trajectory simulation on an electronic data processing machine. The approximations were shown to apply, with the aforementioned 1.0% accuracy, to a wide variety of vehicles with peak altitude capabilities from 60,000 to 6,000,000 feet. In addition, a relationship of unit wind effects to apogee altitude, previously suggested by another author, was verified and methods for its useful employment were demonstrated. Results of studies of nine different sounding rockets designed to test and demonstrate the application of the empirically derived performance approximations, are included. Also included is an appendix which contains graphs which simplify the task of determining exponents for various approximation formulas presented. S.C.W.

N68-13587# New Mexico State Univ., University Park.
A CONTROL SYSTEM FOR REDUCING THE DISPERSION OF MULTI-STAGE SOUNDING ROCKETS
George R. Conrad, H. R. Gleyre, J. Ottesen, and A. S. Hu *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 153–193 (See N68-13581 04-31)
(Contract DAAG-43-67-C-0016)

Presented is a description of the operation and performance of a control system (coast phase control system) for the Nike-Apache sounding rocket vehicle. The capabilities of the control system for reducing trajectory dispersion and/or shaping trajectories are also described. The coast phase control system principle is a simple extension of aiming to an in-flight phase by means of an attitude control system. After activation, this system acts as a nulling device to force rocket attitude to a preset value, thereby removing the directional dispersion accrued prior to activation. The system can also be used to shape the trajectory. It is noted that there is no on-board guidance function. The guidance function is a procedure applied, like those which adjust launcher settings, prior to the fact of firing, in order to establish what conditions the control system is to achieve. The most attractive features of the coast phase control

system are: (1) its capabilities for reducing trajectory dispersion and/or shaping trajectories without compromising vehicle performance; and (2) the adaptability of the concept to other multistage vehicles of similar design. S.C.W.

N68-13588# White Sands Missile Range, N. Mex. Atmospheric Sciences Office.
RESULTS OF UNGUIDED ROCKET IMPACT PREDICTIONS AT WSMR
Gordon L. Dunaway *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 195–214 refs (See N68-13581 04-31)

An analysis is made of the impact dispersion of several types of unguided rockets. The rockets considered are: Athena, Aerobee 150, Nike–Apache, Nike–Cajun, and Arcas. Data are presented in graphical and tabular form. Author

N68-13598# Sandia Corp., Albuquerque, N. Mex. Aero-Thermodynamics Dept.
PROJECT TWINKLE
R. E. Gardner *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 431–448 refs Sponsored by AEC (See N68-13581 04-31)

A series of upper atmosphere experiments was conducted by Sandia Laboratory, using Apache-Dart and Tomahawk-Dart rocket systems. The primary purpose of the experiments was to provide insight into the phenomenon of starlight scintillation. A discussion of the rocket development and experimental programs, with primary emphasis on the aerodynamic characteristics of the rocket and parachute systems, is presented. Author

N68-13603# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
PRELAUNCH REAL-TIME IMPACT PREDICTION SYSTEM FOR THE AEROBEE 350 ROCKET
Henry Rachele and Vertis C. Cochran *In* N. Mex. State Univ. Unguided Rocket Ballistics Meteorol. Conf. 1967 p 605–616 refs (See N68-13581 04-31)

A general description is given for an improved automatic data collection and processing system for use in prelaunch impact prediction of the high altitude, highly wind sensitive Aerobee 350 rocket. The system differs from those presently used at White Sands Missile Range, but fundamentally is an outgrowth of previous developments incorporating recent knowledge on wind sensors and measurement techniques, statistical analyses and prediction techniques, ballistic model refinements, state-of-the-art electronics for wind measurement, and the use of complex high-speed computer programs during countdown operations. Specifically, the major components include the use of a 500-ft. wind tower, multiple pilot balloons, GMD-4 and the FPS-16 radar for upper wind measurements. New data processing techniques include data editing procedures, wind extrapolation in time, and the reduction in time of the operational countdown period. Author

N68-13604# New Mexico State Univ., University Park.
METEOROLOGICAL REQUIREMENTS FOR THE AEROBEE-350
Edward M. D'Arcy *In its* Unguided Rocket Ballistics Meteorol. Conf. 1967 p 617–626 refs (See N68-13581 04-31)

Discussed is the optimum wind layer thickness to be used for the Aerobee-350. These layers should be small near the surface (close to the launcher) but can be relatively large at the top of the profile. The need for wind data above 100,000 feet is discussed. Results show that they are needed for the Aerobee-350. The advisability of firing the Aerobee-350 with a real time met system is discussed and it is concluded that for best results, such a system should be used. Author

N68-13613* Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
DEVELOPMENT OF AN ALGORITHM FOR THE NONLINEAR STABILITY ANALYSIS OF THE ORBITING ASTRONOMICAL OBSERVATORY CONTROL SYSTEM
Gunther R. Geiss, Victor Cohen, and David Rothschild Nov. 1967 127 p refs
(Contract NAS2-4063)
(NASA-CR-73164; RE-307) CFSTI: $3.00 CSCL 22B

This report describes the development of a stability analysis algorithm for estimating the domain of attraction of an equilibrium state of the Orbiting Astronomical Observatory "paired-tracker" control system. The system equations are derived in state variable form for each of two star tracker models. One model is based upon angular rate variables and the other is based on angular variables. The system model based on the latter is shown to have decided advantages for the stability analysis used here. The stability analysis algorithm is developed by phrasing the problem of estimating the domain of attraction as two optimization problems. The stability analysis algorithm suffers from the search algorithm's inability to distinguish local minima from the desired global minimum; a random search algorithm that focuses on the global minimum was developed and shown to be very effective as a check of the stability analysis algorithm and/or a method for generating a search starting point. Author

N68-13797*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PERFORMANCE OF A 19.7-METER-DIAMETER DISK-GAP-BAND PARACHUTE IN A SIMULATED MARTIAN ENVIRONMENT
Richard J. Bendura, Earle K. Huckins, III, and Lucille C. Coltrane Washington Jan. 1968 38 p refs
(NASA-TM-X-1499) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Inflation and drag characteristics of a 64.7-foot nominal-diameter disk-gap-band parachute deployed at a Mach number of 1.59 and a dynamic pressure of 11.6 psf (555 N/m^2) were obtained from the second balloon-launched flight test of the Planetary Entry Parachute Program. In addition, parachute stability characteristics during the subsonic descent portion of the test are presented. After deployment, the parachute rapidly inflated to a full condition, partially collapsed, and then reinflated to a stable configuration. After reinflation, an average drag coefficient of about 0.55 based on nominal surface area was obtained. The parachute exhibited good stability characteristics during descent. The only major damage to the parachute during the test was the tearing of two canopy panels; a loss of less than 0.5 percent of nominal surface area resulted. Author

N68-13827*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
FEASIBILITY STUDY OF HIGH PRECISION TRIAXIAL ATTITUDE CONTROL FOR SPACECRAFT Final Report
Sep. 1967 377 p refs
(Contract NAS12-95)
(NASA-CR-86010; Doc.-67SD4380) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The objective of this study is to determine the feasibility of achieving precision triaxial control and stabilization in the range of 10^{-4} to 10^{-6} degrees of arc for spacecraft of the 1975 to 1980 era. Specific missions were formulated and system concepts were examined for compatibility. Mission objectives and pertinent parameters were delineated. Approaches were derived which are applicable to the formulation of system concepts from which the technical feasibility of these concepts could be assessed. Critical components and subsystems, such as fine error sensors, torquing subsystems, and control logic suitable for use in the control

system, were studied as well as tradeoffs necessary for the selection of the most promising attitude reference and control systems. The choice of missions is narrowed down to laser communications between Earth and a spacecraft in the vicinity of one of the nearby planets or an astronomical telescope. Studied are the transport lag of the laser beam and station switching on Earth and in the spacecraft to maintain pointing direction of the laser. Only unmanned spacecraft with rigid bodies are considered. Mathematical models were formulated for several phases of the feasibility study. Error analyses and subsystem specifications are included. . . . K.W.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-12807# Navy Dept., Washington, D. C.
THEORETICAL AND EXPERIMENTAL STUDY OF THE BLADE MOVEMENT OF A VOITH–SCHNEIDER PROPELLER [TEORETICHESKOYE I EKSPERIMENTAL'NOYE ISSLEDOVANIYE DVIZHENIYA LOPASTI KRYL'CHATOGO DVIZHITELYA]
A. B. Karpov, N. A. Golinkevich, and Yu. L. Panov 12 Oct. 1967 88 p refs Transl. into ENGLISH from Tr. Gor'kovsk. Politekhnicheskogo Inst. Im. A. A. Zhdanova (USSR), v. 19, no. 2, 1963
(Rept.-2469; AD-661186)

A new method of solving problems related to the geometry of a ship hull is explained. This, the so-called parametric method, possesses great universality: first, it enables one to construct ship design curves of water plane areas and curves of cross-sectional areas, in close mathematical agreement with the given geometric parameters, and, secondly, it enables one to obtain simple and sufficiently accurate quadrature formulas for computing areas, the coordinates of the centers of gravity and the moments of inertia of plane figures, bounded by ship-design curves for both constant and variable limits of integration. The parametric method greatly simplifies the work of the designer and computer, making possible a tenfold reduction in time. Moreover, in designing the lines of the hull using the parametric method there is no longer any essential need to determine the theoretical elements of the ships hull sections, since by virtue of this method they will closely correspond to the given geometric parameters. The theoretical elements for the hulls of ships designed using ordinary methods can be computed with high accuracy using the parametric method. Author (TAB)

N68-12864*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NONLINEAR FLUTTER OF A CIRCULAR CYLINDRICAL SHELL IN SUPERSONIC FLOW
David A. Evensen and Mervyn D. Olson (Natl. Aeron. Estab.) Washington Dec. 1967 30 p refs Prepared by National Research Council of Canada
(NASA-TN-D-4265; NRC-LR-486) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A nonlinear analysis is presented for calculating the limiting amplitudes of cylindrical shell flutter by using a four-mode approximation for the shell deflection. The aerodynamic pressure is approximated by linear piston theory, and the nonlinearity enters the problem through the nonlinear shallow-shell equations for the cylinder. The governing equations are reduced to four modal equations by applying Galerkin's method, and limit cycle solutions are obtained by the method of harmonic balance. Stability of the limit cycles is investigated numerically by integrating the modal equations on a digital computer. Two types of limit cycle flutter are obtained: two-mode standing-wave flutter, and four-mode circumferentially traveling-wave flutter. Under most conditions, the two-mode standing-wave flutter becomes unstable and transforms into four-mode traveling-wave flutter. The analysis indicates that flutter can occur at aerodynamic pressures below the linear flutter boundary. This fact may explain why recent results indicate a difference between experiments and linear theory for the flutter of cylindrical shells. Author

N68-12872* General Dynamics/Convair, San Diego, Calif. Structural Analysis Group.
THE STABILITY OF ECCENTRICALLY STIFFENED CIRCULAR CYLINDERS. VOLUME 5: EFFECTS OF INITIAL IMPERFECTIONS; AXIAL COMPRESSION AND PURE BENDING
G. W. Smith and E. E. Spier 20 Jun. 1967 32 p refs
(Contract NAS8-11181)
(NASA-CR-91268; GDC-DDG-67-006) CFSTI: $3.00 CSCL 20K

This is the fifth of six volumes, all bearing the same report number, but dealing with separate problem areas concerning the stability of eccentrically stiffened circular cylinders. The complete set of documents was prepared under NASA Contract NAS8-11181. In this particular volume, practical design curves are presented for empirical knock-down factors. These factors are needed for the reduction of classical theoretical strength values to safe design levels. In view of the relative scarcity of test data for stiffened cylinders, the design curves are based on the use of an effective thickness concept in conjunction with test data from isotropic cylinders. Author

N68-12959# New York Univ., N. Y. Research Div.
KINETICS OF FRACTURE Final Report, Jun. 1964–Sep. 1966
H. Ezrol and H. Margolin Sep. 1967 46 p refs
(Contract Nonr-285(61))
(AD-661339)

An electronic camera, based on an image convertor tube, has been constructed. The image converter is capable of taking photographs at the rate of 200,000 frames per second. It has been used to study, as a function of temperature, the velocity of fracture in notched zinc single crystals, oriented with the basal plane normal to the axis of tensile impact. At room temperature, cracks will develop and grow at a number of locations, including the notch. As temperature is reduced finally only the crack at the notch propagates. If the highest average velocity among a number of cracks, or in the case of a single crack, the highest average velocity is plotted as a function of temperature, it is found that velocity increases as temperature decreases. Proposed velocity-crack length laws and the data obtained are discussed. Author (TAB)

N68-12993# Oklahoma State Univ., Stillwater. School of Mechanical Engineering.
AN INVESTIGATION OF THE STRESSES AND DISPLACEMENTS IN THREE MONOLITHIC SEMIMONOCOQUE SKIN PANELS Final Report, Jul. 1964–Sep. 1967
R. E. Chapel, M. U. Ayres (Boeing Co., Wichita, Kan.), G. C. Stone (Gen. Dyn. Corp., Ft. Worth, Tex.), and J. A. Wallace (Boeing Co., Wichita, Kan.) 15 Sep. 1967 375 p refs
(Contract DA-31-124-ARO(D)-235)
(AS-68-F-6; AD-661651)

Refinement to the direct stiffness method and the redundant force method of structural analysis are used to predict the stress and deflection behavior of three geometric configurations of integrally

reinforced skin panels. The design of the panels simulates the idealizations that are commonly used in airplane structural analysis. Parallel experimental investigations, using a concentration of strain gages, provides a basis for the evaluation of the analytical results. Both of the methods of analysis were modified to include new stiffness and flexibility matrices. Matrix algebra digital computer programs are developed for each method of analysis. Experimental techniques, including data reduction programs based on the least-squares criterion, are presented for the investigation of various types of skin panel structures. It was shown that stresses and displacements for integrally reinforced skin panels can be accurately determined by either the direct stiffness method or the redundant force method. Author (TAB)

N68-13001 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLIED MECHANICS
28 Apr. 1967 31 p refs Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 2, no. 2, 1966 p 36–48
(FTD-HT-66-786; AD-660731)

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2. STRESS CONCENTRATION AROUND A CIRCULAR HOLE IN AN ORTHOTROPIC CYLINDRICAL SHELL Yu. A. Ashmarin p 13–20 refs (See N68-13003 04-32)

N68-13002 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF SHELLS OF REVOLUTION WITH ARBITRARY GENERATRIX CURVATURE
S. S. Kan *In its* Appl. Mech. 28 Apr. 1967 p 1–12 refs (See N68-13001 04-32)

The buckling behavior of shells of revolution with arbitrarily large curvature of the generator, under axial compression and radial pressure, is analyzed by using the energy method. An expression for the critical (buckling) compression force P_{cr} is derived, and it is shown that the expression for P_{cr} previously derived for shells of revolution with small curvature can be used for shells with large curvature by changing the shell parameters accordingly. The known formulas for the buckling force for plain cylindrical and conical shells can easily be deduced from these general expressions. The axially symmetrical and asymmetrical buckling of conical shells is analyzed in this way. The buckling of isotropic shells of revolution generated by revolving a closed curve about its axis of symmetry, subjected to external radial pressure p, is investigated; an expression for determining the external buckling pressure P_{cr} is derived. The buckling of ellipsoids of revolution generated by revolving an ellipse about its major and minor axes, and formulas for the buckling of both types of spheroids are deduced. The buckling of a spheroid under internal pressure is also discussed, and a formula for the internal buckling pressure is given. Author

N68-13003 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRESS CONCENTRATION AROUND A CIRCULAR HOLE IN AN ORTHOTROPIC CYLINDRICAL SHELL
Yu. A. Ashmarin *In its* Appl. Mech. 28 Apr. 1967 p 13–20 refs (See N68-13001 04-32)

A system of equations in displacements which describes the equilibrium of an orthotropic cylindrical shell is written by using the stress-strain relationships of the general theory of anisotropic shells. Expressions for displacement components, forces, and moments derived from this system are given. The Bubnov–Galerkin method is used to obtain a variational equation for stress distribution in an orthotropic cylindrical shell weakened by a hole, and the boundary conditions for cases when the edge of the hole is rigidly reinforced or when it is free. This equation with the boundary conditions is reduced to a system of algebraic equations which can be easily programmed and solved on an electronic computer, so that a complete investigation of the stress and strain distribution around the hole can be performed and the effects of various factors on the stress concentration can be evaluated. A sample analysis of the effect of the anisotropy on the stress concentration in a hole-weakened cylindrical shell subjected to uniform longitudinal compression is presented, and illustrated by a diagram showing the variation of the stress-concentration factor along the edge of a free hole and of a hole with a rigidly reinforced edge. Author

N68-13043# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
STRESS WAVES IN A TEMPERATURE DEPENDENT VISCOELASTIC HALF-SPACE SUBJECTED TO IMPULSIVE ELECTROMAGNETIC RADIATION
G. A. Hegemier and L. W. Morland Oct. 1967 40 p refs
(Grant AF-AFOSR-1226-67)
(AFOSR-67-2453; TR-4; AD-661567)

The absorption of electromagnetic radiation within a thin surface layer of an elastic half space results in a sudden heat source distribution through the layer and stress waves are generated; in particular both tensile and compressive stress are developed. In this paper the effect of viscoelasticity on the tensile stress build-up in the absorption layer is studied for the case of a free surface, uniaxial motion, and where the radiant pulse duration is small compared to the wave travel time through the layer which, in turn, is assumed small compared to the characteristic times of thermal equilibrium and ablation (if any). The radiation induced temperature is assumed to decay exponentially with depth. The viscoelastic model employed is a temperature-dependent standard linear solid incorporating the shift hypothesis. Explicit closed form results, which are obtained describing the propagation of the resulting stress discontinuity, give considerable information on the influence of viscoelasticity. Complete wave forms are obtained numerically for a number of special cases with the aid of the Laplace transform. The cases studied indicate that viscoelasticity can significantly attenuate peak tensile stresses in the layer; compressive stress distributions, on the other hand, remain relatively unaffected. Author (TAB)

N68-13053# Brown Univ., Providence, R. I. Div. of Engineering.
BIREFRINGENCE IN ROTATING STRESS FIELDS
C. Mylonas and G. M. Brown Jun. 1967 48 p refs
(Contract ARPA SD-86; Grant NSF G-20259)
(NSF-G-20259/2; ARPA-E51)

The transformations of the components of a two-dimensional vibration caused by axis rotation and by a relative phase retardation are used to derive three methods for expressing the changes suffered by polarized light travelling through an inhomogeneous stress field, namely the poincare sphere; Neumann's differential equations; and 2×2 complex transformation matrices, and shows their relation with the explicit solution of Drucker and Mindlin. The complex matrix method is applied to the calculation of strain birefringence by alignment and of polarization changes in a stress field with a continuous variation direction and magnitude of principal stress-difference. A comparison with experimental observation shows excellent agreement and indicates some of the difficulties inherent in the problems of birefringence in rotating stress fields. It is hoped that the unified derivation of these methods will facilitate their wider use in photoelasticity. Author (TAB)

N68-13070# Naval Research Lab., Washington, D.C.
COMMON AREAS OF EXPERIMENTAL MECHANICS AND NONDESTRUCTIVE TESTING IN SHOCK AND VIBRATION
I. Vigness *In its* Rept. of NRL Progr. Jun. 1967 p 7–13 refs (See N68-13068 04-34)

Experimental mechanics is concerned with behavior of materials and structures under various loads and excitations. Nondestructive testing is concerned with abnormal behavior that might reveal defects. There are several areas of shock and vibration that are common to both experimental mechanics and nondestructive testing. Recent experiments which involve principally ultrasonic methods have been concerned with flaw detection, residual stress determinations, mensuration, and the determination of elastic constants. Author

N68-13080* National Aeronautics and Space Administration, Washington, D. C.
PHOTOELASTOMETRIC DETERMINATION OF THE STRESS STATE IN THE ZONE CLOSE TO CRACKS IN A CIRCULAR PLATE WITH A CENTRAL HOLE AND OTHER REGULARLY SPACED PERIPHERAL HOLES ON APPLICATION OF UNIFORM PRESSURE TO THE EXTERNAL CYLINDRICAL SURFACE [DETERMINAZIONE FOTOELASTICIMETRICA DELLO STATO DI TENSIONE NELLE ZONE PROSSIME AGLI INTAGLI DI PIASTRE CIRCOLARI CON FORO CENTRALE INTAGLIATO ED ALTRI FORI PERIFERICI REGOLARMENTE INTERVALLATI, SOLLECITATE DA UNA PRESSIONE UNIFORME APPLICATA ALLA SUPERFICIE CILINDRICA ESTERNA]
M. Belgrado and B. Guerrini Dec. 1967 17 p refs Transl. into ENGLISH from Pisa Univ. Rept.
(NASA-TT-F-11371) CFSTI: $3.00 CSCL 20K

Photoelastic measurements of the stress state along the contour of cracks radiating from central and peripheral holes in circular plates, under application of uniform pressure to the external surface, are described with sketches of various models of fuel-bearing core matrices of nuclear reactors. Mathematical formulas are given for individual principal and circumferential stresses, based on studies of the isochromatic and isocline spectra of the various geometric configurations of the models. The results are expressed as a function of the determinable stresses around the central hole in the absence of cracks or peripheral holes. Author

N68-13123# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEM OF NONLINEAR STABILITY OF A ROUND-BOTTOM OBLATE SPHEROIDAL SHELL
Jen-wei Liu 14 Mar. 1967 8 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peking), no. 3, 1965 p 253–255
(Contract AF 33(657)-16409)
(FTD-HT-66-42; AD-661764)

The problem of nonlinear stability of the inner surface of a spherical shell with a central hole under uniform moment distribution was studied using a modified substitution method. The new method enables one to solve the problem under various substituted boundary conditions. The resultant moment along the inner surface can be obtained approximately from the combination of the various substituted boundary conditions. The calculated stability curve indicates the following: (1) the best stability characteristics of a spherical shell are obtained either with a very large or a very small central hole; (2) when alpha = 0.40, the central hole of the spherical shell has a marked effect on the instability of the shell, and the geometrical constant k reaches its minimum value, (k sub 0) min = 12.85. The method can be extended to the same problem with various boundary and load conditions. TAB

N68-13130# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
IMPROVEMENT OF METHODS AND EXPERIMENTAL SET-UPS FOR CREEP-PLASTICITY TESTS [AMELIORATION DES MOYENS ET METHODES D'ESSAIS EN PLASTICITE-FLUAGE]
Andre Monthulet 1967 53 p refs In FRENCH; ENGLISH summary
(ONERA-TN-114(1967))

One-dimensional test equipment and methods are examined, and a systematic analysis of the main causes of errors during experimentation is made in order to establish testing rules and a method for creep-plasticity tests. Two and three-dimensional testing problems are considered, along with examples. Details are included for a study of the various parameters important to testing, namely time, temperature, constraints, deformation, and speed of deformation. It is concluded that caution must be taken in interpreting results related to the resistance of materials in the plasticity domain and, specifically, in the case of creep. This is because a scattering of results is observed that is attributed to the testing conditions and errors in measurement rather than to the intrinsic characteristics of the materials being tested. Transl. by M.W.R.

N68-13154# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FREE OSCILLATIONS OF LINEAR SYSTEMS WITH VARIABLE PARAMETERS
F. A. Mikhaylov 2 May 1967 272 p refs Transl. into ENGLISH from "Svobodnyye Kolebaniya Lineynykh Sistem s Peremennymi Parametrami" Moscow, Gostoptekhizdat., 1961 p 1–272
(FTD-MT-64-93; TT-67-62506; AD-656559)

The book presents the principles of the theory of oscillations of linear systems with variable parameters, gives the results of investigations of the stability of oscillations, and examines the means for analyzing oscillations in a finite time interval. This book is intended for scientific workers and engineers who encounter, during their their work, questions of the theory of oscillations and, in particular, for specialists in the calculation of the flight dynamics of flight vehicles and specialists in automatic control. TAB

N68-13157* Republic Aviation Corp., Farmingdale, N. Y.
USERS MANUAL FOR FREE VIBRATION ANALYSIS OF STIFFENED CYLINDERS WITH AN ATTACHED WEIGHT
Sol Davis 1 Jul. 1966 57 p refs Revision A
(Contract NAS8-11514)
(NASA-CR-91282; RAC-1117-11, Rev. A) CFSTI: $3.00 CSCL 20K

This program computes the approximate natural frequencies and mode shapes of pressurized circular cylinders with equally spaced, flexible stringers with an attached point mass. It may also be used for cylinders with radially stiff rings by treating this case as a shorter cylinder. Exact normal modes for the linearized orthotropic shell equations are used to obtain results for the stiffened configuration without a mass attachment. Linear combinations of these are next employed as trial functions to approximate the shell deflections with an attached mass. Author

N68-13232* TRW Systems, Redondo Beach, Calif.
STUDY OF MECHANICAL SHOCK SPECTRA FOR SPACECRAFT APPLICATIONS. APPENDIX 3: DIGITAL COMPUTER PROGRAM USERS MANUAL
[1967] 30 p
(Contract NAS5-10166)
(NASA-CR-91384) CFSTI: $3.00 CSCL 20K

User information is described for a digital program to compute mechanical shock and Fourier response spectra for a base-excited and viscous damped single degree-of-freedom oscillator. A digital

filter technique is used to compute the spectrum for the following response parameters: (1) Fourier variable, (2) relative displacement, (3) relative velocity, and (4) absolute acceleration; and either printed or printed and plotted output may be obtained. Input formats for all of the program functions are presented, along with special operating instructions. A sample problem illustrates the input and output formats for commonly used program options. The presented program offers the advantage of shorter run time as compared to an existing program. A typical response spectrum for an excitation pulse with 21 frequencies and 2000 data points requires less than one minute machine time; and doubling the number of frequencies does not double the run time. M.W.R.

N68-13266# Michigan Univ., Ann Arbor. Dept. of Civil Engineering.

POST BUCKLING BEHAVIOR OF TEE SHAPED ALUMINUM COLUMNS

Rafi Hariri (Ph.D. Thesis) Jun. 1967 231 p refs
(Contract NBy-45819)
(Rept.-05154-3-T; AD-661860)

The post buckling behavior of a tee shaped column of aluminum alloy was studied. Attention was focused on the cases where the buckling is initiated in the plane of symmetry. The effects of initial curvature and eccentric loading in the plane of symmetry and in the directions towards or away from the flange received consideration. In the cases where the buckling starts in the direction away from the flange, the flange of the tee section is subjected to increasing compressive stress and there are corresponding decreases in the value of the tangent modulus while increasing areas of the web are subjected to strain regression at the elastic rate. A series of tests was conducted to confirm the theoretical predictions. To carry out the experiments, a procedure of measuring the lateral displacements and the twist of the hinged-end columns in combined bending and torsion was developed. The results of the incremental analyses are presented in the form of tables and graphs. These results include the ultimate load carrying capacity of tee columns of various slenderness ratio with various amounts of initial crookedness in buckling towards or away from the flange, comparison of initial crookedness and the eccentric loading, comparison of the assumed half-sine curve deflection shape and the more exact deflection shape, some selected graphs of the load-deflection history and finally the results of the experiments in the form of a table and some graphs. Author (TAB)

N68-13270# Blume (John A.) and Associates Research Div., San Francisco, Calif.

RESPONSE OF STRUCTURES TO SONIC BOOMS PRODUCED BY XB-70, B-58, AND F-104 AIRCRAFT BASED ON SONIC BOOM EXPERIMENTS AT EDWARDS AIR FORCE BASE Final Report

John A. Blume, R. L. Sharpe, G. Kost, and J. Prouix Oct. 1967 378 p refs
(Contract AF 49(638)-1739)
(NSBEO-2-67; AD-662003)

The response of test structures and structure elements to sonic booms produced by XB-70, B-58 and F-104 aircraft was studied. These aircraft produced sonic booms of different signature durations. They were flown at several flight track offsets, altitudes and Mach numbers so as to generate different overpressure levels and signature characteristics. Free field signature data and the effects of free field signature parameters on structural response were analysed. Studies were made of the plate response (lateral deformation) and racking response (in-plane deformation) of the test structures. Damage complaints resulting from the test missions were investigated and the results analysed. The implications of the magnitudes of the responses of the test structures and the investigation of the damage claims resulting from the test missions on possible damage caused by supersonic flights were discussed. Author (TAB)

N68-13290# California Univ., La Jolla. Dept. of Aerospace and Mechanical Engineering Sciences.

DYNAMIC SNAP-THROUGH OF AN ELASTIC IMPERFECT SIMPLE SHALLOW TRUSS

N. C. Huang and B. Vahidi Oct. 1967 21 p refs
(Grant AF-AFOSR-1226-67)
(TR-5; AFOSR-67-2452; AD-661588)

In order to understand the effect of geometrical imperfections on the dynamic buckling of shallow structures thoroughly, a study was made on the dynamic snap-through phenomena of an elastic weightless symmetric three-hinged shallow truss with a point-mass attached at the middle hinge. The applied load was considered to have an infinite duration. The members of the truss was assumed to be slightly curved so that the axial and lateral deflections would occur simultaneously. It was found that the critical load for snap-through decreases remarkably due to the existence of geometrical imperfections although the magnitudes of imperfections are infinitesimally small. The effect of the flexibility of the members on the critical load was also studied. Author (TAB)

N68-13298# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.

END THERMAL STRESSES IN A LONG CIRCULAR ROD

Wen-hwa Chu and Franklin T. Dodge 7 Feb. 1967 39 p refs

This report shows that application of the Laplace transform to the problem of thermal stress calculation for a long rod fails to satisfy the boundary conditions automatically. The problem is solved here by the method of collocation utilizing complex nonorthogonal characteristic functions. Ten characteristic values are obtained by repeated linear interpolation. For large temperature gradients, an example is given which shows high end stresses. The general solution due to the end effect dies on the steepness of the temperature gradient. This report also shows that the Saint-Venant principle may not always be valid and that the end stress could be critical and, therefore, should be calculated. Author

N68-13313# California Univ., San Diego. Aerospace and Mechanical Engineering Sciences Dept.

ON THE RESPONSE OF SHALLOW THIN SHELLS TO RANDOM EXCITATIONS

S. Nemat-Nasser Nov. 1967 20 p refs
(Grant AF-AFOSR-1226-67)
(TR-6; AFOSR-67-2511; AD-661972)

Statistical parameters of the displacement field of a linearly elastic shell are formulated in terms of the corresponding parameters of the loads. The example of a circular, cylindrical panel is considered, and for the simply supported case the second order correlation function of the radial displacement under a purely random pressure is worked out in detail. Several interesting features of the response are discussed. Author (TAB)

N68-13314# General Technology Corp., Lawrenceville, N. J.

STRESS DISTRIBUTION IN A STIFFENED CIRCULAR CYLINDRICAL SHELL WITH A CIRCULAR CUTOUT UNDER HYDROSTATIC PRESSURE

M. M. Stanisic, J. A. Euler, E. H. Dowell, and A. C. Eringen Aug. 1967 106 p refs
(TR-7-1; AD-661332)

The report covers the theoretical analysis of a cylindrical shell with a circular cutout and stiffened internally with equally spaced rings. The shell is considered to be infinitely long, capped

at the ends and subjected to internal pressure. The exact solution of the partial differential equations of Donnells and Flugges theories of thin cylindrical shells is obtained in the form of an infinite series. Fourier expansions and the method of least square error are employed to satisfy the boundary conditions. Typical numerical results for the case of two ring stiffeners are presented at the end of the report. Author (TAB)

N68-13318 College of Aeronautics, Cranfield (England). Dept. of Materials.

MEASUREMENT OF THERMAL CYCLES IN THE WELD HEAT AFFECTED ZONE OF MILD STEEL

M. D. Coward and R. L. Apps Sep. 1967 15 p refs
(COA-Note-Mat.-13)

The thermal cycles in the mild steel parent plate adjacent to a bead on plate weld have been measured for heat inputs of 108, 54 and 42 kJ/inch, by means of embedded thermocouples connected to high response automatic recorders. The results show that decreasing the heat input increases the cooling rate and decreases the width of the heat affected zone. For thermal cycles in which the peak temperatures reached 900°C or above, two points of inflection have been noted in the temperature ranges 400°–600°C and 950°–1200°C. The inflection in the lower temperature range, which has been observed by other workers, has been attributed to latent heat from the exothermic transformation of austenite to ferrite. The higher inflection point, not previously reported, has been tentatively related to the solidification in the weld pool and the release of the latent heat of fusion. Author

N68-13321# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE STATIC STRENGTH OF METALS IN CONDITIONS OF A COMPLEX STRESSED STATE AND LOW TEMPERATURES [O STATICHESKOY PROCHNOSTI METALLOV V USLOVIYAKH SLOZHNOGO NAPRYAZHENNOGO SOSTOYANIYA I NIZKIKH TEMPERATUR]

P. F. Koshelev *In its* Acad. of Sci. of the USSR News Mech. 18 Apr. 1967 p 1–8 (See N68-13320 04-23)

An attempt is made to evaluate to what degree a complex stress condition affects the strength of metals under nomal and low temperatures. The complex stress condition discussed is typified by the stresses in the metal about a recess in a grooved metal cylinder under axial loading. Two basic hypotheses are developed: 1) the transition from nearly linear to planar and thence to a predominantly three-dimensional stress state occurs gradually with greater groove depth ranging from very shallow (surface) to deep grooves, and 2) on grooves with uniform depth and size of the least section with various curvature there occurs a variation of the local stress and also changes in the values of other stress components, but the character of these variations is invariant in terms of dimensionality (linear, planar, or global) and is not a function of curvature. Experiments were performed to test the hypotheses. Author

N68-13357*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.

A STUDY OF JOINT DISCONTINUITY IN VIBRATIONS OF COMPOSITE SHELLS

William C. L. Hu 12 May 1966 41 p refs
(Contract NASr-94(06); SwRI Proj. 02-1504)
(NASA-CR-91556; TR-6) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The vibrational characteristics of composite (cone–cylinder) shells are investigated analytically and experimentally. The behavior of the circular joint connecting the conical and the cylindrical shell components is discussed in detail. Both the analysis and the experimental results reveal that the derivatives of the mode functions are discontinuous at the joint, where a V-shaped minimum of normal displacement was observed in all modes being excited. It is evident that dynamic stress concentration is involved even in free vibrations of such shell structures. The jump conditions are formulated for the cone–cylinder joint, and various approaches of solving this problem are discussed. Author

N68-13379# Boeing Co., Renton, Wash. Commercial Airplane Div.

A METHOD OF MEASURING CRACK PROPAGATION RATES IN BRITTLE MATERIALS

Ned M. Lowry, Owen R. Mulkey, J. Michael Kuronen, and James W. Bieber May 1967 11 p refs
(Contract N0014-66-C-0365; ARPA Order 878)
(D6-60072; AD-661814)

A method of measuring the rate of crack propagation is described. The method, applicable to any specimen having a smooth surface across which brittle-type fracture will occur, is accomplished by means of a fine gridwork of conducting lines applied to the specimen by various vacuum deposition techniques. When a potential is applied to the grid, a direct reading of current (or distance) versus time is obtained with a strip chart recorder or equivalent device. The method has been applied to the study of brittle-type fracture associated with stress corrosion cracking observed in titanium alloys. Author (TAB)

N68-13384# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Mechanical Engineering.

DYNAMICS AND VIBRATIONS OF HOMOGENEOUS AND LAYERED PLATES AND SHELLS, INCLUDING THOSE OF SANDWICH CONSTRUCTION Final Scientific Report, 1 Jan. 1964–31 Aug. 1967

Bernard Koplik Sep. 1967 11 p refs
(Contract AF 49(638)-1290)
(AFOSR-67-2368; AD-661569)

The dynamics and vibrations of homogeneous and layered plates and shells, including those of sandwich construction were investigated. Reports on the following subjects were written: (a) linear equations of anisotropic elastic plates, (b) linear equations of isotropic elastic plates and shells, (c) damping parameters of layered plates and shells, (d) dynamic buckling of plates, (e) vibrations of two-layered plates, (f) axisymmetrical vibrations of conical shells, (g) axisymmetric vibrations of spherical shells, (h) torsional vibrations of spherical caps and circular plates, (i) nonlinear vibrations of plates and shells. Author (TAB)

N68-13385# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Mechanical Engineering.

ON NONLINEAR EQUATIONS OF ISOTROPIC ELASTIC SPHERICAL SHELLS

Perry L. Grossman and Bernard Koplik Sep. 1967 31 p refs
(Contract AF 49(638)-1290)
(AFOSR-67-2254; SR-10; AD-661568)

A complete and consistent system of dynamic equations including the effect of thickness-shear deformation is derived for isotropic elastic spherical shells. This is accomplished by adopting a generalized variational equation of motion based on simplified nonlinear elasticity theory involving finite deflections and carrying out the integration in the thickness direction. The displacement equations of motion and boundary conditions are then deduced for the transverse axisymmetric vibrations of spherical caps which are supported such that the transverse displacement vanishes at the edge. Author (TAB)

N68-13414# Naval Weapons Center, China Lake, Calif.
PENETRATION MECHANICS AND POST-PERFORATION EFFECTS IN AN ALUMINUM-ALUMINUM IMPACT SYSTEM
Marvin E. Backman and William J. Stronge Oct. 1967 70 p refs
(NWC-TP-4414; AD-661833)

The perforation of 0.040-, 0.125-, and 0.250-inch 2024-T3 aluminum alloy plates by 0.063-, 0.125-, and 0.281-inch 2024-T8 aluminum spheres was investigated for the impact velocity range from 1.0 to 4.0 km/sec. The object of the investigation was to determine the mechanism of the formation of fragments, the distribution of fragment velocities and sizes, and the relation of atmospheric disturbances to these properties of the fragment system. The projectiles were launched from a conventional powder gun and from a light-gas gun both of which are 0.5 inch in barrel diameter. The investigation used an Electro-Optics Kerr cell camera, paraffin and celotex techniques of particle recovery, and measurements of momentum by a ballistic pendulum. Pressures of atmospheric disturbances were estimated from highspeed photographs of the shocks and directly by piezoelectric gages mounted in the top of a box to which the target plate is mounted. Pressure measurements were found to correlate in a general way to the kinetic energy of the particle system but show no significant contribution from the combustion of aluminum in air. The pressures from 0.125- and 0.040-inch targets were essentially the same. Author (TAB)

N68-13553# Advisory Group for Aerospace Research and Development, Paris (France).
THE INFLUENCE OF FRETTING ON FATIGUE
W. J. Harris 1967 36 p refs Presented at the 24th Meeting of AGARD, Unione Industriale, Turin, Italy, 17–26 Apr. 1967
(AGARD-8) CFSTI: HC $3.00/MF $0.65

Evidence to support the claim that fretting must be ranked in importance with geometric stress concentration and the like, when considering the fatigue behavior of structures, is presented. Mean structures curves, crack propagation and non-propagating cracks, and some fundamental fretting fatigue researches are described and interpreted with the elucidation of the fretting fatigue mechanism in mind. A survey of certain anti-fret techniques has been included not only to emphasize the gains to be made in terms of structural efficiency but to justify the main thesis that primarily, the fretting fatigue mechanism is controlled by the stress fields generated by the contact of two surface topographies. Author

N68-13732# Southwest Research Inst., San Antonio, Tex.
PARAMETRIC OSCILLATIONS OF A LONGITUDINALLY EXCITED CYLINDRICAL SHELL CONTAINING LIQUID Final Report
Daniel D. Kana (Ph.D. Thesis) 1 Jan. 1967 136 p refs

Parametric oscillations of a liquid filled, circular cylindrical shell experiencing forced longitudinal excitation are investigated analytically, and numerical results are compared with experimental observations for several principal parametric modes. It is found that the linear axisymmetric forced response of the liquid-shell system forms an initial state in which the axisymmetric pressure forms a parametric loading with respect to nonaxisymmetric coupled modes of the system. A perturbation technique is used to form the equations governing the perturbed, or variational state. A linear analysis of the perturbed state leads to a Mathieu equation which predicts the dynamic stability of the system. A nonlinear form of the shell displacements in the perturbed state leads to coupled nonlinear equations which are solved by methods of approximate analysis in order to predict the amplitude response of the nonlinear motion during the parametric resonance. Author

N68-13774# Southwest Research Inst., San Antonio, Tex.
EXPERIMENTAL STUDY OF THE STRESSES NEAR AN OBLIQUE ELLIPTICAL APERTURE IN A LARGE PLATE
Philip H. Francis and John F. Gormley (AiResearch Corp., Phoenix) Nov. 1967 26 p refs

This report presents the results of an experimental program designed to investigate the stress distribution in the neighborhood of an elliptical aperture in a moderately thick stressed plate, when the axis of the aperture is introduced obliquely to the plate surface. Author

N68-13794 Sandia Corp., Albuquerque, N. Mex.
SPALLATION IN 6061-T6 ALUMINUM
B. M. Butcher [1967] 8 p refs Presented at the High-Dyn. Pressure Symp., Paris 11–15 Sep. 1967 Sponsored by AEC

The work described in this paper is concerned with the effect of microstructure on crack initiation and propagation. First, the effect of microstructure on crack formation will be discussed, then crack propagation will be considered; evidence of the influence of inclusions and impurity precipitates on crack formation and propagation will be presented. Finally, the relative strengths of 6061-T6 and 1060 aluminum will be discussed. Author

N68-13813
FINE STRUCTURE OF COMPRESSIVE AND RELEASE WAVE SHAPES IN ALUMINUM MEASURED BY THE VELOCITY INTERFEROMETER TECHNIQUE
L. M. Barker [1967] 24 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967 Sponsored by AEC

A new laser interferometer technique has been developed to measure the velocity history of a reflecting surface of a shock-loaded specimen. The velocity interferometer configuration overcomes the formerly reported distance interferometer limitation of being able to monitor only relatively small velocities. Some preliminary results are included on wave shapes in 6061-T6 Aluminum shocked to various pressures up to 90 kbar. The maximum strain rate in the plastic wave front increases from 0.13×10^6 sec^{-1} for a 20 kbar experiment to 1.5×10^6 sec^{-1} for a 37 kbar experiment. The shape of the elastic release wave is found to be considerably more smeared-out than expected, and computer analysis of the measured results indicates the influence of a strong Bauschinger effect on the unloading behavior of the aluminum. Author

N68-13817# Boeing Scientific Research Lab., Seattle, Wash. Flight Sciences Lab.
RESPONSE OF STRUCTURE TO THE PSEUDO-SOUND FIELD OF A JET (USING A COMBINED CONTINUUM AND FINITE ELEMENT METHOD)
L. Maestrello, M. R. Gedge, and A. R. F. Reddaway Sep. 1967 46 p refs
(D1-82-0652; Rept.-118)

Prediction techniques are applied to a typical aircraft panel of size $7\times12\times0.080$ inches mounted along, and just outside of the wake of a model jet. From measurements made, a functional representation of the pseudo-sound wall pressure correlation is obtained and is used to predict the response characteristics of the panel. The predicted mean square response is in fair agreement with the measured values, but the predicted displacement spectra are somewhat erroneous. Author

N68-13823# Advisory Group for Aerospace Research and Development, Paris (France).
HANDBOOK OF BRITTLE MATERIAL DESIGN TECHNOLOGY

W. H. Dukes London Harford House 1966 80 p refs Presented at the 23d Meeting of the AGARD, Paris, Oct. 1966 CFSTI: HC $3.00/MF $0.65

A comprehensive description of the design technology of brittle nonmetallic refractory materials is presented in terms of differences from conventional design. Ten areas where changes in brittle material design practice are necessary are discussed. These include refined stress analysis, design principles at joints, improved mechanical property test methods, failure mechanisms, establishment of material failure modes, statistical definition of fracture strength, improved material process control and inspection, methods of achieving high allowable stresses, new design concepts, and optimization concepts. The establishment of design stresses is discussed in terms of structural design philosophy, analytical relationships, and a procedure for determining failure probability of a brittle component. An example of the method of computing failure probability of a structural component is included. Several charts and other information are included to facilitate the application of the design practices discussed. R.N.A.

N68-13832 General Motors Research Labs., Warren, Mich. Materials and Structures Lab.

USE OF A LIGHT GAS GUN IN STUDYING MATERIAL BEHAVIOR AT MEGABAR PRESSURES

W. M. Isbell, F. H. Shipman, and A. H. Jones 15 Sep. 1967 19 p refs Presented at High Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

Parameter measurements of gun shock wave induced multi-megabar pressures in flat plates of high impedance materials were used to describe the thermodynamic state of the specimens. Relation of these measurements to the determination of Hugoniot equations of state and the release wave properties of the materials were made and extended to determine the isentropes from high pressure, and the elastic and plastic release wave behavior. G.G.

N68-13834 Novosibirsk State Univ. (USSR).

FORMATION OF DEFECTS IN SOLIDS UNDER SHOCK WAVES

S. S. Batsanov, S. S. Derbenjova, G. S. Doronin, and E. V. Dulepov [1967] 8 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

We have investigated the topography of defect formation in nitrates of alkali metals. For this purpose, capsule contents after shock wave compression was divided into four parts perpendicular to cylinder axis, with each part investigated separately. The averaged values for alkalinity as well as dielectric permeability of sodium and potassium nitrates are tabulated. A spectroscopy investigation also revealed change in nitrates of alkali metals after shock wave compression. Author

N68-13838 Akademiya Nauk SSSR, Novosibirsk.

THE EFFECT OF THE SHOCK AND DETONATION WAVES ON THE PROPERTIES OF SOME METALS AND ALLOYS

A. Deribas, M. Mogilewsky, and T. Sobolenko [1967] 11 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967

The response of various metals and alloys to explosive loading is investigated and results are presented for shock wave loading of low carbon steel, titanium, copper, and aluminum alloys. The shock waves were generated in metal plates driven by tangential detonation waves. In addition, shock loading of single crystals of zinc was investigated. Author

N68-13847 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF INTERNAL PRESSURE ON THE STRESS STATE OF A CYLINDRICAL SHELL WITH BENDING [VLIYANIYE VNUTRENNEGO DAVLENIYA NA NAPRYAZHENNOYE SOSTOYANIYE TSILINDRICHESKOY OBOLOCHKI PRI YEYE IZGIBE]

E. V. Antonenko *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 55–62 refs (See N68-13841 04-28)

A solution is presented to the problem of thin-walled cylindrical shells subjected to transverse bending and axisymmetrical pressure. In one case, consideration is given to the stress state of a shell under a load, which is constant along its length and under simultaneous axisymmetrical radial pressure; boundary conditions are assumed to be arbitrary. Equations are derived for the pertinent force factors. It is shown that the presence of an internal radial pressure or of a positive axisymmetrical radial load component, under conditions of transverse bending, substantially reduces the ring bending moments and, to a lesser degree, reduces additional axial stresses. External pressure increases ring bending moments and, to a lesser degree, increases additional axial forces. Two examples are given: (1) The stresses are determined in the midsection of a cylindrical steel pipeline, horizontally positioned and hinge-supported on frames which are absolutely rigid in their planes but whose planes are free to move. (2) Maximum stresses are calculated for a one-span Duralumin, freely suspended, cylindrical shell with a length-constant load along one generatrix. Author

N68-13848 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILITY OF AN ANISOTROPIC, CIRCULAR-CYLINDRICAL SHELL UNDER THE JOINT ACTION OF EXTERNAL PRESSURE AND LONGITUDINAL FORCES [USTOYCHIVOST' ANIZOTROPNOY KRUGOVOY TSILINDRICHESKOY OBOLOCHKI PRI SOVMESTNOM DEYSTVII VNESHNEGO DAVLENIYA I PRODOL'NYKH USILIY]

V. V. Kabanov *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 63–72 refs (See N68-13841 04-28)

The buckling of the circular-cylindrical anisotropic shell of medium length is analyzed in linear formulation. The faces of the shell abut on diaphragms, which are rigid in their planes, and it is subjected to longitudinal (tensile or compressive) forces. A stability equation is used to derive exact expressions from which the minimum buckling load and other parameters can be determined. Approximate expressions describing the buckling of the shell are deduced, and the range of their applicability is pointed out. The effect of tensile and compressive axial forces on wave forming is discussed. Results of a numerical calculation of critical loading for certain geometrical and rigidity parameters of the shell are shown graphically. Design formulas for the following particular cases of shell anisotropy are deduced: isotropic shell, orthotropic shell, and constructionally orthotropic shell (stiffened by both stringers and frames). Author

N68-13849 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A PRACTICAL METHOD OF DETERMINING STRESSES IN JOINTS OF TUBES WITH THIN-WALLED BODY ELEMENTS [PRAKTICHESKIY METOD OPREDELENIYA NAPRYAZHENIY V SOCHLENENIYAKH TRUBOK S TONKOSTENNYMI KORPUSNYMI ELEMENTAMI]

Kh. S. Khazanov and Yu. L. Tarasov *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 73–84 refs (See N68-13841 04-28)

Results are presented of theoretical and experimental investigations of very simple models in which tubes (cylindrical

shells) are welded to plates. The case of axisymmetrical loading is considered to determine the magnitude of the bending moment which arises along the contour of the tube–plate joint. Equations of the general theory of cylindrical shells and of axisymmetric bending of circular plates are derived. It is noted that the experimental studies conducted on different samples are in agreement with the mathematical calculations. Author

N68-13857 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE CALCULATION OF THIN-WALLED BEAM CONSTRUCTIONS BY THE METHOD OF SUCCESSIVE APPROXIMATIONS [RASCHETU TONKOSTENNYKH KARKASIROVANNYKH STERZHNEY SPOSOBOM POSLEDOVATEL'NYKH PRIBLIZHENIY]
Ye. G. Solov'yev *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 168–174 refs (See N68-13841 04-28)

An attempt is made to overcome the difficulties encountered in the integration of the system of equations which apply to the problem of designing weakly conic, thin-walled, hulled rods with an open or closed cross sectional outline. A beam analog is used and applied to a sample problem for which computational results are tabulated. This method, even in the first approximation, permits secondary stresses in the elements for a longitudinal assembly to be obtained with an acceptable accuracy. Two to three approximations are completely sufficient for practical purposes. The graph analytic method makes it possible to find in the first approximation the secondary axial stresses in elements of the longitudinal assembly of a weakly conic, thin-walled rod with grooves. Author

N68-13876 Naval Ordnance Lab., White Oak, Md.
THE SPLIT HOPKINSON PRESSURE BAR
James L. Rand and John W. Jackson (Maryland Univ., College Park) [1967] 11 p refs

An analysis is made of data obtained by a split Hopkinson pressure bar, and the assumptions underlying such an analysis and their effect on the resulting stress–strain information are considered. Although the presence of axial inertia does not cause nonuniform distributions of stress, strain, and rate of strain except in the case of yield stress and modulus, the various averaging processes result in a reasonable approximation of the actual stress–strain relation. Experimental studies indicate that the effects of friction and radial inertia are also negligible. A wave propagation technique is shown to be valid for obtaining the slope of a dynamic stress–strain relation. The fact that wave propagation results for commercially pure aluminum are not in agreement with those from the split Hopkinson bar technique is explained by the lack of rate insensitivity data on the yield stress for wave measurements. These data do not invalidate the split Hopkinson bar technique, but rather demonstrate the rate insensitivity of the aluminum for a wide variety of strains. M.W.R.

N68-13888 Los Alamos Scientific Lab., N. Mex.
THE DETERMINATION OF NEW STANDARDS FOR SHOCK WAVE EQUATION-OF-STATE
R. G. McQueen, S. P. Marsh, and W. J. Carter [1967] 13 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967 Sponsored by AEC

To obtain Hugoniot equation of state data by means of the shock wave impedance match technique, it is necessary to know the hydrodynamic equation of state of some material for use as a standard. To establish the new shock wave standards, materials with low, intermediate, and high shock impedances were selected. Aluminum 2024 and 921-T, deoxidized annealed copper, and a uranium alloy were the respective selections. The experimental techniques used to determine the Hugoniots are discussed. Experimental studies are also described in which the Hugoniots of aluminum 2024, copper, and iron were measured using samples of lower initial density to determine the Gruneisen parameter needed to calculate the reflected shock curves and pressure-release isentropes required for impedance match solutions. The results of an experimental check, using aluminum 2024 as a standard, were encouraging and showed that with reasonable care a standard can be used over a considerable pressure range. The effect of rigidity on shock waves is briefly discussed. R.N.A.

N68-13892# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
STUDY OF A CYLINDRICALLY LAMINATED SYSTEM AS APPLIED TO A FIBROUS COMPOSITE
A. Levy Nov. 1967 32 p refs
(RM-389)

A cylindrically laminated system, under a tensile load, is analyzed with the use of the linear equations of elasticity and appropriate stress functions. The results are applicable to various models of a single discontinuous fiber embedded in a matrix and to a localized region of a multifiber composite. Some qualitative features are presented and compared with existing results. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-12815# Los Alamos Scientific Lab., N. Mex.
AN IMPROVED CALCULATION OF THE IDEAL GAS THERMODYNAMIC FUNCTIONS OF SELECTED DIATOMIC MOLECULES
R. C. Feber and C. C. Herrick Sep. 1968 70 p refs
(Contract W-7405-ENG-36)
(LA-3597) CFSTI: HC $3.00/MF $0.65

Ideal gas thermodynamic functions of selected diatomic molecules were calculated to 6000°K at 100°K intervals by direct summation over experimental and extrapolated vibrational–rotational levels of electronic states, which contribute to the functions at the maximum temperature. The procedure used for the extrapolation of energy levels allows for cutoff of both vibrational and rotational quantum numbers. Thermodynamic functions are tabulated for F_2, Cl_2, Br_2, I_2, HF, HCl, HBr, HI, Li_2, Na_2, K_2, B_2, C_2, and HgH. Author (NSA)

N68-12829# Bureau of Mines, Pittsburgh, Pa.
THERMODYNAMICS OF NONLINEAR ELECTROMAGNETIC-FLUID SYSTEMS
W. F. Hughes Jan. 1968 13 p refs
(BM-RI-7066)

The thermodynamics of an electromagnetic field–fluid interaction system is discussed. A review of the thermodynamics of linear media (the permittivity and permeability taken as functions of density and temperature) is presented; and an extension is made to nonlinear media (the permittivity and permeability taken as functions of the fields). Expressions for thermodynamic properties and reversible work are derived, and the first law of thermodynamics for magnetohydrodynamic flow is discussed. Author

N68-12832# Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France). Div. Satellites.
DIAGRAMS FOR CALCULATING RECIPROCAL EMISSIVITIES AND EFFICIENCIES [ABAQUES POUR LE CALCUL DES EMISSIVITES RECIPROQUES ET EFFICACES]
C. Elbaz Nov. 1967 17 p refs In FRENCH
(CNES-NT-7)

Diagrams are presented that permit the calculation of reciprocal emissivities and efficiencies that occur during the exchange of radiant energy between diffuse isothermal surfaces. Construction of the diagrams is discussed, as are their use and the modification of the scales for the diagrams. Transl. by M.W.R.

N68-12850 Royal Aircraft Establishment, Farnborough (England).
FLAME STABILIZATION IN SUPERSONIC FLOWS AT LOW GAS TEMPERATURES [FLAMMENSTABILISIERUNG IN UEBERSCHALLSTROEMEN BEI NIEDRIGEN GASTEMPERATUREN]
G. Winterfield Jun. 1967 22 p refs Transl. into ENGLISH from German Presented at Ann. Meeting of WGLR, Bad Godesberg, W. Germany, Oct. 1966
(RAE-LIB-TRANS-1230) CFSTI: $3.00

First experiments on the stabilization of flames by recirculation zones in supersonic flow are reported. A special form of Damköhler's first number as a criterion for flame stability, valid also for supersonic flow is given. It shows that the maximum blow-off velocity increases with the square of the laminar flame velocity. The validity of the given criterion was checked experimentally for premixed flames with propane, ethylene and approximately for hydrogen. Furthermore experiments with hydrogen diffusion-flames stabilized on axisymmetric flame holders of cylindrical cross-section are described. Blow-off limits for different flame holder diameters at a stagnation temperature of 375°K in the Mach number range between 0.8 and 1.7 have been measured. Interactions between the flow field and the flame in supersonic flow have been observed by which the length of the recirculation zone can be considerably influenced. Author

N68-12857 TRW Systems, Redondo Beach, Calif.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF HEAT PIPES
L. G. Neal Jan. 1967 37 p refs
(TRW-99900-6114-R000; EM-17-5)

An analysis of the heat pipe is conducted which results in some design equations and gives a criterion by which working fluids and capillary materials may be chosen. Several heat pipe fluids are evaluated and the best fluids for various temperature ranges are chosen. The experimental effect investigated factors which determine good capillary structures. Three types of capillary materials were used in heat pipe operation. Two heat pipe designs were built and operated to determine their capacities and the mechanism by which they fail. One pipe was frozen and subjected to a startup test at a low power level to investigate the possibility of bringing a heat pipe back to life. The heat pipes were operated using both water and ethyl alcohol as working fluids. R.N.A.

N68-12858* Boeing Co., Seattle, Wash.
IN SITU ULTRAVIOLET RADIATION EFFECTS ON THERMAL CONTROL COATINGS
S. S. Cannaday [1967] 119 p refs
(Contract NAS5-9650)
(NASA-CR-91351; D2-84118-8; QPR-8) CFSTI: $3.00 CSCL 20M

Ultraviolet radiation studies were conducted on 14 thermal control coating types previously examined, plus two coating types of interest in the OAO program. Measurements of spectral reflectance in the wavelength region from 240 to 2500 millimicrons were obtained in situ on a total of 46 samples, before exposures began, and following exposures of 18, 53, 120, 135, 250, 490, 770, and 1130 equivalent UV sun hours. Data obtained from these measurements were analyzed for spectral reflectance changes. Author

N68-12898# University Coll. of Swansea (Wales).
THERMAL INSULATION IN RELATION TO CRYOGENICS
S. D. Probert Risley, Engl. United Kingdom Atomic Energy Authority 1967 115 p refs
(TRG-1455(R/X)) HMSO: 15s

Modern cryogenic container designs are considered, and in particular the means of inhibiting heat leaks across the vacuum space via radiation, conduction and convection; via the vapor above the boiling refrigerant; by thermal conduction along the neck through which filling, venting and emptying occur; through mechanically strong supports between the inner and outer shells. This requires outlining the physical processes governing heat transfer through solids and fluids, and leads to a description of some recent studies of the thermal resistance of pressed contacts. It is found that the thermal insulation figure of merit, namely yield stress divided by thermal conductivity, for multi-layer stacks of a stainless steel in compression compares very favorably with those for solid insulators. More sophisticated means of inhibiting heat leaks via mechanically strong supports are suggested; in particular microthermoelectric heat pumps and electromagnetic levitators are criticized. Author

N68-12899* Scientific Translation Service, La Canada, Calif.
TEMPERATURE FIELD IN MULTILAYER SYSTEMS WITH VARIABLE THERMOPHYSICAL PROPERTIES [TEMPERATURNOYE POLE V MNOGOSLOYNYKH SISTEMAKH S PEREMENNYMI TEPLOFIZICHESKIMI SVOYSTVAMI]
I. G. Meyerovich Washington NASA Nov. 1967 10 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 12, no. 4, 1967 p 484–490
(Contract NASw-1496)
(NASA-TT-F-11444) CFSTI: $3.00 CSCL 20M

Description of a method for solving nonlinear heat-conduction problems by dividing the space-time region into a series of subregions within which the time characteristics and coordinates are assumed to be stationary. The problem is thus reduced to the solution of a sequence of subordinate linear problems of multilayer systems with the original boundary conditions. The solution thus obtained is presented. Author

N68-12954# Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
SYSTEM REQUIREMENTS FOR THERMAL CONTROL COATINGS
Eugene N. Borson Sep. 1967 31 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-20)-2; SAMSO-TR-67-83; AD-661983)

The main factors usually considered in the selection of thermal control coatings for spacecraft are as follows: (a) Optical properties and their quantitative uncertainties. (b) Application, ground environment, and cleaning. (c) Atmospheric heating. (d) Particulate and ultraviolet radiation stability. (e) Outgassing, toxicity, and flammability. (f) Mechanical properties. (g) Cost. (h) Availability. These items are discussed and examples are presented. Attention is given to optical property uncertainties, and typically used coatings are used as examples. Author (TAB)

N68-12968 Aeronautical Research Council (Gt. Brit.).
HEAT TRANSFER IN THE VICINITY OF A 15° COMPRESSION CORNER AT MACH NUMBERS FROM 2.5 TO 4.4
R. C. Hastings, C. S. Brown, and Susan Atkinson London HMSO 1967 36 p refs Supersedes RAE-TR-66171; ARC-28406 See X67-10713
(ARC-CP-965; RAE-TR-66171; ARC-28406) HMSO: 7s

Commercially available heatmeters have been used to measure the steady state heat transfer rates in the vicinity of a compression corner. Results at all Mach numbers are qualitatively similar in that, both ahead and downstream of the corner, the measured heat transfer rate was lower than expected. In the compression region close to the corner, the adiabatic wall temperatures were also low. The measuring technique is discussed and some potential sources of error are indicated. Author

N68-12974 Los Alamos Scientific Lab., N. Mex.
SHOCK-WAVE COMPRESSION OF POROUS MAGNESIUM AND AMMONIUM SULFATE
J. O. Johnson and Jerry Wackerle [1967] 6 p refs Presented at the High-Dyn. Pressure Symp., Paris, 11–15 Sep. 1967 Sponsored by AEC

Shock compressions of pressings of nonreactive materials, with crystal densities approximately those of common solid explosives, were investigated. The planar shock waves were transmitted for Lucite driver plates, and the streak-camera method was employed to measure the velocities of the shock waves and of the free-surface motions. The disk shaped porous pressings were magnesium powder with a density of 1.30 g/cc, and ammonium sulfate samples with densities of 1.30, 1.60, and 1.73 g/cc. The data are tabulated and graphed, and models for the shock propagation are discussed. N.E.N.

N68-12975# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.
PROGRESS IN THE STUDY OF THE L.A.S. THERMAL CONTROL
R. Somoza Paris ESRO Jan. 1967 11 p
(ESRO-TM(P)-94) CFSTI: HC $3.00/MF $0.65

The progress is reported on the study of L.A.S. (Large Astronomical Satellite) thermal control up to the moment of the ESTEC (European Space Technology Center) fire. The starting point for the thermal control studies is explained and the phases performed up to now described, in relation with the thermal analysis and with the refinement of methods. The later steps of the thermal study that had not yet been started but that were planned for the near future, are briefly described. Author (ESRO)

N68-13067# Argonne National Lab., Ill.
THERMODYNAMIC PROPERTIES OF TUNGSTEN IN THE TEMPERATURE RANGE 0–2400°C [TERMODINAMICHESKIE SVOISTVA VOL'FRAMA V INTERVALE TEMPERATUR 0-2400°C]
V. A. Kirillin, A. E. Sheindlin, and V. Ya. Chekhovskoi Mar. 1967 11 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 9, no. 3, 1962 p 63–66
(ANL-TRANS-452) CFSTI: HC $3.00/MF $0.65

The thermodynamic properties of tungsten were investigated at 0 to 2400°C and the enthalpy was determined at 2000 to 2340°. Experiments were carried out with four specimens with less than 0.05% admixture in a vacuum or in argon at 1.05 atm. NSA

N68-13170*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
INFLUENCE OF SURFACE ROUGHNESS AND WAVINESS UPON THERMAL CONTACT RESISTANCE
M. Michael Yovanovich and Warren M. Rohsenow Jun. 1967 174 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951621)
(NASA-CR-91440; TR-6361-48; Rept.-76361-48) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Reported is a study of the phenomenon of thermal resistance between contacting solids which focuses on contiguous solids possessing both surface roughness and waviness. When two such surfaces are brought together under load, they actually touch at isolated microcontacts, and the resulting real area is the sum of these microcontacts. Because of the waviness the microcontacts are confined to a region called the contour area which may occupy some fraction of the total available area. The non-uniform pressure distribution over the contour area results in microcontacts which vary in size and density. In the absence of an interstitial fluid and negligible radiation heat transfer, all the heat crossing the interface must flow through the microcontacts. A thermal analysis, based on size and spatial distribution, results in a thermal resistance equation which differs from previously developed theories. The equation is verified by liquid analog tests which show that the size and spatial distribution are very significant. A surface deformation analysis considers the influence of surface roughness upon the elastic deformation of a rough hemisphere. An equation is developed which shows the extent of the contour area as a function of the surface geometry, the material properties, and the applied load. The equation is compared with existing theories and qualitatively checked against experimental results. Experimental heat transfer data were obtained to verify the thermal and deformation theories. Agreement between theory and test was good over a large range of surface geometry and applied loads. Author

N68-13179*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
A METHOD FOR DETERMINING CATALYTIC EFFICIENCY OF SURFACES
I. O. Bohachevsky and D. F. DeSanto Feb. 1967 43 p refs
(Contracts NAS5-9978; NAS5-3976; AF 49(638)-1487)
(NASA-CR-91388; CAL-AI-2187-A-4; AFOSR-67-2246; AD-659446) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A method is described which is used to determine numerically the relationship between the catalytic efficiency (gamma) of a surface and the heat transfer (q) through the surface in low Reynolds number flow of a partially dissociated gas. The work is motivated by the fact that heat transfer is easily measurable in the laboratory whereas catalytic efficiency is not. The approach is directed towards the derivation of a relationship between gamma and the surface concentration of free atoms (c-o); once this relationship is known, it is used to eliminate c-o from the expression relating gamma and q, obtainable from energy balance and from the kinetic theory of gases. To establish the required relationship between gamma and c-o, a mixed boundary value problem for the convective diffusion equation is formulated and solved numerically using an implicit, alternating-direction iteration procedure. The concentration of free atoms is determined not only along the surface, but also throughout the flow field. Results are obtained for a cylinder partially coated with a catalytic substance; they reveal the effect of the velocity field and point out the need for better quantitative knowledge of the low Reynolds number flow. In addition, parameter values for the best experimental accuracy are delineated. Author (TAB)

N68-13223# Stanford Research Inst., Menlo Park, Calif.
RESPONSE OF A BURNING PROPELLANT SURFACE TO EROSIVE TRANSIENTS Quarterly Report, 1 Jul.–30 Sep. 1967

G. A. Marxman and C. E. Wooldridge 10 Nov. 1967 21 p refs
(Contract AF 49(638)-1665)
(QR-7; AFOSR-67-2495; AD-661575)

The formulation of an analytical model has been initiated, to clarify the gasdynamical mechanism by which the combustion mechanism, responding to pressure pulses induced by traveling shock waves in the chamber, interacts with the shock waves to produce combustion instability. The approach taken in this analysis is similar to that used to study the behavior of shock waves in shock tubes; it differs in that it employs a modified surface boundary condition that accounts for the mass added by the combustion process. The nonlinear equations that describe the combustion model were programmed for numerical solution. The program will be used to predict the burning rate response of the combustion mechanism to steep-fronted pressure waves; this calculation will provide the proper boundary conditions for the gasdynamical studies. Author (TAB)

N68-13225# Brown Univ., Providence, R. I. Div. of Engineering.
A CLOSING DISCUSSION ON THERMODYNAMICS AND THE INTERFACE BETWEEN MACRO AND MICRO-MECHANICS OF SOLIDS
D. C. Drucker Sep. 1967 25 p Presented at the Symp. on the Mech. Behavior of Mater. Under Dyn. Loads, 6–8 Sep. 1967
(Contract Nonr-562(20))
(TR-55; Nonr-562(20)/55; AD-661351)

Unifying instructive classifications of physical behavior are required which contain the essence of the macroscopic problem. Such ideas as using plastic work or plastic strain as a state variable wont do because they are trivially over simple. On the other extreme, a continual change of phase without thermodynamic prescription is impossibly general even if true in the strictest physical sense. Some concept between an assemblage of well-defined states and a continual unspecified irrestorability or phase change is required. What should be done is to worry far less about general mathematical consistency and to concentrate on the physical aspects. These must be put down in clear and reasonably acceptable form before it is worthwhile subjecting them to formal mathematical treatment. Author (TAB)

N68-13238# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRACE METHOD AND ITS APPLICATION TO THE INVESTIGATION OF DISPERSED-FUEL COMBUSTION KINETICS [METOD TREKOV I EGO PRIMENENIYE K ISSLEDOVANIYU KINETIKI GORENIYA DISPERGIROVANNOGO TOPLIVA]
V. A. Fedoseyev 2 Jun. 1967 10 p Transl. into ENGLISH from Teplofiz. i Teplotekhn. (Kiev), 1964 p 136–139
(FTD-HT-66-706; AD-661898)

In 1957-1958, the author presented and experimentally verified an original method of investigating the combustion kinetics of dispersed metallic fuels and the evaporation and combustion of droplets and particles by the so-called trace method. The method is explained as follows: If a small particle (droplet) is introduced into a hot (1000C) airstream flowing inside a glass pipe, it reaches the flow velocity in a very short (0.00001 sec) time interval and becomes stationary relative to the air. The particle (droplet) is progressively heated to the ignition temperature. During combustion it moves with the flow, leaving a trace which will be more or less bright, depending on the burning velocity. Various combustion characteristics, such as the change in diameter and surface of the particle as a function of time, may be determined by trace photography. The length of the trace may be measured with a photometer. Author (TAB)

N68-13293# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE THEORY OF FUSION AND BURNING OF A BODY (STEFAN PROBLEM) [K TEORII OPLAVLENIYA I OBGORANIYA TELA (ZADACHA STEFANA)]
A. A. Pomerantsev 12 Apr. 1967 23 p refs Transl. into ENGLISH from Teplo- i Massoperenos (Moscow), v. 3, 1963 p 185–194
(FTD-MT-65-267; AD-661772)

A deficiency of the known theories of fusion is the use of a motionless frame of reference, in describing the phenomena, although in reality the boundary condition is expressed by the thermal balance of the fused element of a substance on a moving boundary. For its satisfaction a conclusion is made about the constancy of the arguments of the functions expressing the state of the thermal balance in the region of fusion. It is necessary to note that for the composition of the balance particular solutions, rather than general solutions, are used. In general, it is possible to compose a great number of particular solutions of the problem. Hence one can obtain the same great number from the differential equations and the problem loses the property of singleness. Such uncertainty of the method of solution of the problem impelled the author to search for new methods of its solution. TAB

N68-13312# Maryland Univ., College Park. Inst. for Molecular Physics.
THERMAL DIFFUSION AND OTHER TRANSPORT PHENOMENA IN GASES Final Report, 1 Sep. 1965–31 Aug. 1967
E. A. Mason 31 Aug. 1967 6 p refs
(Grant DA-ARO(D)-31-124-G817)
(AROD-5366.14-P; AD-661644)

A summary is given of research involving both experimental and theoretical work. The experimental work had two aspects: (1) measurement of thermal diffusion and diffusion in gases as a technique for the study of forces between unlike molecules; (2) study of a new diffusion phenomenon, in which convection instabilities develop spontaneously in diffusing multicomponent mixtures. The theoretical work, which was closely related to the experimental, aimed at a better understanding of transport and other molecular collision phenomena in gases. TAB

N68-13346* National Aeronautics and Space Administration, Washington, D. C.
QUANTUM THEORY OF SCALAR FIELD WITH NONSTATIC SOURCE [KVANTOVAYA TEORIYA SKALYARNOGO POLYA S NESTATICHESKIM ISTOCHNIKOM]
M. I. Shirokov Dec. 1967 13 p refs Transl. into ENGLISH from Lab. of Theoretical Physics, Dubna (USSR), 1966
(NASA-TT-F-11243) CFSTI: $3.00 CSCL 20M

A procedure was established for solving quantum field problems of the scattering type and the arbitrary Cauchy problem. The model of an electromagnetic field with an external current is developed. Author

N68-13360* National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THE ABLATION OF LOW-MELTING MODELS ON A BALLISTIC FACILITY [ISSLEDOVANIYE UNOSA MASSY LEGKOPLAVKIKH MODELEY NA BALLISTICHESKOY USTANOVKE]
S. N. Palkin, B. I. Reznikov, A. M. Studenkov, and V. N. Bykov Nov. 1967 13 p refs Transl. into ENGLISH from Aerofizicheskiye Issled. Sverkhzvukovykh Techenii. (Moscow), 1967 p 274–283
(NASA-TT-F-11309) CFSTI: $3.00 CSCL 20M

Ablation tests performed on a small free-flight ballistic facility with models made of Wood alloy and Rose metal are discussed. The optimum conditions for a ballistic trajectory are determined, and a method for calculating the ablation parameters is proposed. Author

N68-13401# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.

REPORT ON TWO UNFINISHED STUDIES RELATED TO THERMAL CONTROL

A. Accensi Paris ESRO Jan. 1967 9 p

(ESRO-TM(D)-69; ESRO-TM(P)-86) CFSTI: HC $3.00/MF $0.65

Two independent thermal studies are described: (1) One compares the thermal balance conditions of a simple satellite model under under different light sources in order to evaluate the dependence of the equilibrium condition on the type of sun simulator used for the vacuum chamber tests. (2) The other investigates the precision and reproducibility of the shape factor measurements obtained with a factometer, compares the magnitude of these errors with those from other sources of imprecision and evaluates their effect on the results derived from the thermal balance equations. Author (ESRO)

N68-13441# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

HEAT TRANSFER MEASUREMENTS WITH A CATALYTIC FLAT PLATE IN A NONEQUILIBRIUM EXPANSION OF OXYGEN Interim Technical Report, Jul. 1966–Jun. 1967

J. A. Bartz Arnold Air Force Station, Tenn. AEDC Nov. 1967 31 p refs

(Contract AF 40(600)-1093)

(CAL-AF-1905-A-3; AEDC-TR-67-249; AD-661985)

Heat transfer data are presented which were obtained with a sharp flat plate having surfaces both catalytic and noncatalytic to oxygen atom recombination. The plate was inclined at a compressive angle to the flow to provide a constant-pressure flow field in which the measurements could be readily interpreted. The experiments were made in a shock tunnel using oxygen-argon mixtures as the test gas. Test conditions were chosen such that the flow was in thermochemical nonequilibrium. The intent of the experiment was to illustrate the application of this probe configuration as a diagnostic tool in a high temperature test facility. The shock tunnel conditions necessary to produce a meaningful experiment are reviewed. In addition, the procedures for conditioning the catalytic surface and reducing data are discussed. Typical data traces are presented to show that the catalytic probe can be used to determine the end of the period of useful test flow. The data obtained with the catalytic and noncatalytic surfaces compare favorably with boundary-layer theory which accounts for Prandtl number effects and variations of the (density)(viscosity)-product in the boundary layer. The ratio of catalytic-to-noncatalytic heat transfer rate is interpreted with the theory to infer the ambient stream atom mass fractions. The inferred mass fractions are in fair agreement with values computed for relevant oxygen dissociation-recombination rates. Author (TAB)

N68-13454 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany). Inst. fuer Strahlantriebe.

CONTRIBUTION FOR THE REPRESENTATION OF COMBUSTION PROCESSES IN THE PRESSURE-VELOCITY-DIAGRAM [BEITRAG ZUR DARSTELLUNG VON VERBRENNUNGSVORGAENGEN IM P, W-DIAGRAMM]

W. Alvermann and M. Kallergis Jun. 1967 35 p refs In GERMAN; ENGLISH summary

(DLR-FB-67-61)

For heating air by chemical combustion some factors have to be regarded which are not existent for other heating procedures; for instance electrical heating. This paper describes a study of air-heating by combustion considering the kind and condition of fuel. The change of massflow which must be heated (air+fuel) and the necessary cross-sections for the flow of gaseous fuels must be regarded. The air heating process is represented in a pressure-speed-diagram. There are lines of constant air-fuel-ratio plotted instead of lines of constant heat addition. For heat addition liquid and gaseous fuels are used. Author

N68-13480* National Aeronautics and Space Administration, Washington, D. C.

STUDY OF HEAT TRANSFER OF A TURBULENT FLUID FLOW IN A PLANE CURVED CHANNEL [ISSLEDOVANIYE TEPLOOBMENA PRI TURBULENTNOM TECHNII ZHIDKOSTI V PLOSKOM KRIVOLINEYNOM KANALE]

D. A. Nusupbekova and B. P. Ustimenko Dec. 1967 11 p refs Transl. into ENGLISH from Vestn. Akad. Nauk Kaz. SSR (Alma-Ata), v. 22, no. 1, 1966 p 47–54

(NASA-TT-F-11382) CFSTI: $3.00 CSCL 20M

Results of an experimental study of heat transfer in a turbulent flow of an incompressible fluid in a plane curved channel, at Reynolds numbers from 50,000 to 178,000. The temperature profile and the coefficient of heat transfer are determined, showing that heat transfer in a plane curved channel (R=1.15) is roughly 20 to 25% greater than in comparable plane straight channels, and that the coefficient of heat transfer on the outside wall of a curved channel is roughly two times as high as that on its inside wall. Hydrodynamic formulas of heat transfer in a well developed turbulent flow in a plane curved channel are set up. Author

N68-13513# Royal Aircraft Establishment, Farnborough (England).

THERMAL INSULATION OF SMALL INSTRUMENTATION PROBES

T. W. Chubb Feb. 1967 27 p refs

(RAE-TR-67034) CFSTI: HC $3.00/MF $0.65

Some methods of preventing the rapid overheating of small instrumentation packages or probes when placed in a high temperature (200×19°C) environment are presented in this report. Long term operation (greater than 30 minutes) requires active cooling and involves either greatly increased size or loss of independence of operation. The existing state of thermoelectric cooling is studied and rejected as a means of active cooling in this application. Short term operation (less than 30 minutes) is feasible using standard dorms of insulation and heat sinks. Author (ESRO)

N68-13559 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf.

TEST LENGTHS FOR THE DYNAMICS OF HEAT TRANSFER IN STEAM–WATER MIXTURES

H. Schmidl [1967] 17 p refs Presented at the Symp. on Two Phase Flow Dyn., Eindhoven, Austria, 4–8 Sep. 1967

(SGAE-RT-13/1967) CFSTI: $3.00

A test length for dynamics measurements on single and two phase flow will be described. It consists mainly of two concentric tubes with 4 and 12 cm diameters respectively. The tubes are divided in an input, a middle, and an output part. Only the middle section is instrumented at different places, in order to measure temperature, velocity, pressure and void. The thermocouples and the Pitot gages can be moved in radial direction. The time constants of all instruments are small. The transient response and the transfer function of heat transfer, the radial temperature or velocity distribution and the friction losses at single and two phase flow will be measured. The void ratio will be measured at the input and output of the test length. Author

N68-13618* Florida Univ., Gainesville. Dept. of Mechanical Engineering.
FIREBALL AND POST-FIREBALL COMPOSITION AND ATMOSPHERIC CHEMISTRY OF FUEL/OXYGEN–FLUORINE PROPELLANTS
E. A. Farber, R. E. Stewart, C. F. Bonzon, and A. Hernandez 21 Jul. 1967 162 p
(Contract NAS10-1255)
(NASA-CR-91531) CFSTI: $3.00 CSCL 21B

This report discusses liquid propellant composition and interaction with the atmosphere after an explosion has been initiated and a fireball has been formed, is gradually growing and then changing into a combustion products cloud. With the volume-time, pressure-time, and temperature-time history available, the mathematical equations controlling these processes were set up and then computer solutions worked out to give the desired results. Normalized results are presented as : (1) fuel consumption versus time; (2) volume of entrained air versus time; (3) partial pressures versus time, and partial volumes versus time; and (4) partial weights versus time. Author

N68-13642# Lehigh Univ., Bethlehem, Pa. Inst. of Research.
MATHEMATICAL AND EXPERIMENTAL INVESTIGATION OF THERMAL INITIATION OF EXPLOSION Progress Report, 1 Jul.–30 Sep. 1967
1 Oct. 1967 7 p
(Contract DA-28-017-AMC-1090(A))
(AD-661673)

A summary is given of studies involving the influence of particle size and other parameters on the decomposition and minimum explosion temperature of lead azide in the range 210C to 260C. TAB

N68-13654 Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
LAMINAR HEAT TRANSFER TO A TWO-DIMENSIONAL BLUNT FLAT NOSED BODY IN TRANSONIC AND SUPERSONIC FLOW
Josef Rom and Arnan Seginer Sep. 1967 43 p refs
(Contract F61052-67-C-0033)
(TAE-74; SR-3)

Heat transfer rates are measured on a two-dimensional, blunt, flat nose and in the separated and reattaching flow regions of the separation bubble behind the leading edge corners in the high enthalpy laminar transonic and supersonic flow in the shock tube. The measurements are carried out in a shock Mach number range from 2.5 to 10, and a corresponding flow Mach number from approximately 0.4 (the flow being choked) to 2.7. The Reynolds number, which is based on half of the nose height, varies from 8×10^2 to 3.3×10^4 and the local Reynolds number on the flat plate section, behind the leading edge corners, based on the distance from the stagnation point varies from 1×10^3 to 1.5×10^5. The results are correlated in terms of: (Nu/Pr), $(q/\sqrt{P_t})$ and $(Nu/PrRe^{1/2})$ as functions of Mach and Reynolds numbers and stagnation to wall enthalpy ratios. The variations of local maximum and average heat transfer rates on the nose section and in the separation bubble region behind the corner are presented. Author

N68-13679 Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
FUNDAMENTAL ASPECTS OF BOILING PHENOMENA [ASPETTI FONDAMENTALI DELL'EBOLLIZIONE]
M. Cumo 4 Sep. 1967 315 p refs In ITALIAN; ENGLISH summary
(RT/ING(67)15)

The systematic employment of dimensional analysis throughout the various aspects of boiling phenomena supports an organized view in which are inserted experimental results from many laboratories. Whenever possible, the author has adopted well known theoretical procedures which best explain particular boiling aspects. Author

N68-13739 European Atomic Energy Community, Ispra (Italy).
2.4 MW PRESSURE AND BOILING-WATER LOOP FOR HEAT TRANSFER STUDIES [2,4 MW DRUCK- UND SIEDEWASSERKREISLAUF ZUR UNTERSUCHUNG DES WARMEUBERGANGS]
H. Herkenrath and P. Mork-Morkenstein Brussels Sep. 1967 33 p refs In ITALIAN; ENGLISH summary
(EUR-3605.D)

One of the most significant directions of the development of light water reactors is the application of higher system pressure. This development led to an extensive experimental program in the framework of the heat transfer division of the Research Center of Euratom at Ispra, in the investigation of heat transfer with water in the pressure range up to 230 bar. The following report describes the experimental facilities of this program, with special regard to the water test loop which allows investigations of test sections of realistic dimensions with a maximum power input of 2.4 MW. Author

N68-13764 Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
METHOD OF MEASURING THERMAL FLUX OF WALLS BY THERMOSENSITIVE PAINTS [METHODE DE MESURES DES FLUX THERMIQUES PARIETAUX PAR PEINTURES THERMOSENSIBLES]
Jean Ponteziere and Betremieux 1967 21 p refs Presented at the Maritime and Aeron. Tech. Assoc., Paris, 24–27 Apr. 1967 In FRENCH
(ONERA-TP-470(1967))

A method, developed for measuring kinetic heating in a hypersonic wind tunnel by means of thermal sensitive paints, is described. Details are given on the experiments pertaining to the choice of a material with very low diffusion, the theoretical studies of the isothermal lines, and the determination of the transmission coefficients. An analysis of the error sources inherent in the procedure is included. Transl. by M.G.J.

N68-13798* City Coll. of the City of New York.
BLADE TEMPERATURE RESPONSE OF THE ROTOR ENTRY VEHICLE
Latif M. Jiji Aug. 1967 108 p refs
(Grant NGR-33-013-026)
(NASA-CR-91511) CFSTI: $3.00 CSCL 20M

An analysis is made of the temperature response of refractory coated blades of the Rotor Entry Vehicle during atmospheric entry. The mathematical model used in the analysis consists of a composite slab insulated on one side and exposed to a time dependent oscillating heat flux on the other side. An exact analytical solution for the temperature response is obtained for a non re-radiating surface. A numerical solution is also obtained which incorporates the effect of re-radiation on the temperature behavior. The effect of re-radiation on the temperature level during entry is found to be significant and favorable. Oscillation in the aerodynamic heat flux, which is due to blade rotation, results in temperature oscillation during entry. The amplitude of temperature oscillation is negligible for rotor angular velocities which are of practical interest in the Rotor Entry Vehicle. Author

N68-13812 Swedish Detonic Research Foundation, Stockholm.
MEASUREMENTS OF DETONATION PRESSURES IN CONDENSED EXPLOSIVES AT LOW AND HIGH INITIAL DENSITIES
Algot Persson and Per-Anders Persson [1967] 12 p refs Presented at the High-Dyn. Pressure Symp., Paris 11–15 Sep. 1967

In the multiple flash-gap technique, shock wave velocities in transparent materials are measured from recordings of light flashes generated by the shock wave passing through a stack of transparent plates separated by thin air gaps. When the stack is placed in contact with a detonating charge, detonation wave pressures can be deduced provided the detonation velocity and shock data of the transparent material are known. In the present experiments, measurements have been extended to low initial densities and pressures by the use of a fast photomultiplier. For PETN, the results at low initial densities are not in agreement with Mader's calculated data from the Becker–Kistiakowsky–Wilson equation of state. Author

N68-13835# California Univ., Livermore. Lawrence Radiation Lab.
A FORTRAN PROGRAM (TEMCAL) FOR CALCULATION OF HUGONIOT TEMPERATURES, ISOTHERMS, AND RELEASE ADIABATS FROM HYDRODYNAMIC DATA
Franklin E. Walker 27 Mar. 1967 30 p refs
(Contract W-7405-ENG-48)
(UCRL-50210) CFSTI: HC $3.00/MF $0.65

A FORTRAN program (TEMCAL) was written to calculate Hugoniot temperatures from experimental hydrodynamic data. The program also derives a least-squares fit to the data, calculates isotherms and release adiabats, and gives graphic presentations of data and solutions. Author (NSA)

N68-13855 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF CERTAIN THERMODYNAMIC PARAMETERS OF SUBSTANCES BY THE SIMILARITY METHOD [OPPREDELENIYE NEKOTORYKH TERMODINAMICHESKIKH PARAMETROV VESHCHESTV S POMOSHCH'YU METODA PODOBIYA]
B. M. Pankratov *In its* News of Schools of Higher Educ. Aeron. Engr. 21 Mar. 1967 p 152–158 refs (See N68-13841 04-28)

A method is presented for calculating the parameters of moist lithium vapor over the entire region limited by the boundary curves and in the superheated vapor region adjacent to the outer boundary curve. Three steps are involved in the computation: (1) select a group of thermodynamically similar substances, including those which have been studied experimentally and others with unknown thermodynamic parameters; (2) determine the critical parameters necessary to establish the corresponding states of the base substance and the substance to be studied; and (3) construct a dimensionless $\bar{i}$–$\bar{s}$ diagram for the thermodynamically similar substances, in which $\bar{i}$ and $\bar{s}$ are dimensionless values of enthalpy and entropy. For the case of lithium, when temperature and pressure regions up to the critical are considered, approximate extrapolation of the high temperature and pressure properties is achieved by introducing the corresponding conversion coefficients for the dimensionless functions of thermodynamically dissimilar substances. M.G.J.

N68-13880 Naval Ordnance Lab., White Oak, Md.
A THEORETICAL INVESTIGATION OF THE VALIDITY OF THE CLASSICAL DETONATION WAVE STRUCTURE FOR CONDENSED EXPLOSIVES AND THE EFFECT OF THE STRUCTURE ON THE EXPERIMENTAL OBSERVATIONS
Francis J. Petrone [1967] 9 p refs Presented at the High-Dyn. Pressure Symp., Paris 11–15 Sep. 1967

A series of numerical computations were carried out to obtain an accurate solution to the flow problem to determine whether the reaction and its effect on the value of the deduced Chapman–Jouguet (C–J) pressure may be neglected for thin plates. The results indicate that the approximations for treating a detonation wave adjacent to a metal plate as a nonreactive shock wave should be valid provided the second break is interpreted as the C–J plane. It is concluded that the interpretation of free surface velocity measurements supports the classical theory and results in values of C–J parameters which are in agreement with measured and predicted C–J values. N.E.N.

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-12854 Taft (Robert A.) Sanitary Engineering Center, Cincinnati, Ohio. Lab. of Engineering and Physical Studies.
CONTINUOUS AIR MONITORING PROGRAM IN WASHINGTON, D. C. 1962–1963
Public Health Serv. Sep. 1966 225 p refs
(PB-173987)

The operation of the Public Health Service Continuous Air Monitoring Program (CAMP) in Washington, D. C., during 1962 and 1963 is described. Data on atmospheric levels of sulfur dioxide, oxides of nitrogen, total oxidants, total hydrocarbons, and carbon monoxide are analyzed. The data are tabulated as hourly, daily, and monthly mean concentrations; background information about Washington and a description of the instrumentation used are included. Author

N68-12918 Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
Apr. 1967 39 p refs
(PB-174485)

CONTENTS:

1. COMPARISON OF NEUTRON FLUX VALUES OBTAINED BY SIMULTANEOUS IRRADIATION OF FISSION AND THRESHOLD MONITORS C. Z. Serpan, Jr. and L. E. Steele p 1–4 refs (See N68-12919 04-22)
2. AIRGLOW HORIZON PHOTOGRAPHY FROM THE GEMINI SPACECRAFT M. J. Koomen, R. T. Seal, Jr., and J. Lintott p 5–11 refs (See N68-12920 04-14)
3. PROBLEM NOTES p 12–34 refs
4. PUBLISHED REPORTS p 34
5. PAPERS BY NRL STAFF MEMBERS p 35–39

N68-12921 Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
Aug. 1967 55 p refs
(PB-175806)

CONTENTS:

1. THE TOTAL ELECTROMAGNETIC ENERGIES POSSESSED BY CONVECTION CURRENTS J. W. Butler p 1–17 refs (See N68-12922 04-23)

2. SHIELDING OF SOLAR CELLS AGAINST VAN ALLEN BELT PROTONS C. A. Carosella p 18–23 refs (See N68-12923 04-03)

3. PROBLEM NOTES p 24–47 refs

4. SUPPORTING TECHNIQUES p 48–49 refs

5. PUBLISHED REPORTS p 49

6. PAPERS BY NRL STAFF MEMBERS p 50–52

N68-13011*# Washington Univ., St. Louis, Mo. Dept. of Economics.

ORGANIZATIONAL EFFECTS UPON MANPOWER UTILIZATION IN RESEARCH AND DEVELOPMENT

Richard A. Goodman (Ph.D. Thesis) Dec. 1967 178 p refs *Its* Working Paper No. 6715

(Grant NsG-342)

(NASA-CR-91280) CFSTI: HC $3.00/MF $0.65 CSCL 05C

The effect of two basic types of organizational form on the stability and flexibility of manpower in research and development companies engaged in various projects for the United States government. Important criteria for selecting one organizational form rather than another were also explored, since such criteria provided the rationale for choosing a specific organizational form. Specifically, the project management and the matrix management forms of organization were investigated within the context of the defense/aerospace sector of the United States economy. A series of hypotheses were developed and tested concerning the influence of these forms of organization on manpower flexibility, turnover, staff planning, and organizational choice. Author

N68-13065# Naval Research Lab., Washington, D. C.

REPORT OF NRL PROGRESS

Mar. 1967 43 p refs

(PB-174294)

CONTENTS:

1. THERMAL AND ELECTRICAL RESISTIVITIES OF RHENIUM FOR 2°K TO 20°K J. T. Schriempf p 1–5 refs (See N68-31066 04-26)

2. ROLE OF LOCAL DISSOLUTION IN CORROSION-ASSISTED CRACKING OF TITANIUM ALLOYS J. M. Krafft p 6–18 refs (See N68-13067 04-17)

N68-13068# Naval Research Lab., Washington, D. C.

REPORT OF NRL PROGRESS

Jun. 1967 52 p refs

(PB-174978)

CONTENTS:

1. THERMOLUMINESCENT DOSIMETERS OF LITHIUM BORATE E. J. West, A. E. Nash, F. H. Attix, R. D. Kirk, and J. H. Schulman p 1–6 refs (See N68-13069 04-26)

2. COMMON AREAS OF EXPERIMENTAL MECHANICS AND NONDESTRUCTIVE TESTING IN SHOCK AND VIBRATION I. Vigness p 7–13 refs (See N68-13070 04-32)

N68-13095# Mitre Corp., Bedford, Mass.

A SYSTEMATIC PROCEDURE FOR ASSESSING THE WORTH OF COMPLEX ALTERNATIVES

James R. Miller Nov. 1967 204 p refs

(Contract AF 19(628)-5165)

(MTR-260; ESD-TR-67-90; AD-662001)

The paper addresses itself to the problem of assessing worth. It is assumed that a decision context has been specified and that a fixed set of discrete alternatives has been produced. It then remains to assess the worth of each alternative, to estimate the resource drains required by each, and to combine these considerations, along with considerations of risk/uncertainty, so as to arrive at a final decision. The bulk of this paper is directed toward worth assessment. To aid in the assessment process, a detailed procedure has been devised. The purpose of this procedure is set forth, and step-by-step instructions for its actual implementation are presented. A live instance of its complete application is also provided for illustrative purposes. Major conclusions are that the procedure can be carried out successfully--at least by professional decision makers in a laboratory setting--and that all phases of it exert an important impact upon the decision making process. Critical to its overall impact, and particularly to its success, are its quantitative aspects. Author (TAB)

N68-13117 Congress. House. Committee on Appropriations.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION APPROPRIATIONS FOR FISCAL YEAR 1968

Warren G. Magnuson Washington GPO 1967 222 p Hearings before Comm. on Appropriations, 90th Congr., 1st Sess.

The hearings on the 1968 budget for the NASA program are presented, and details are given on the research and development aspects, construction of facilities, and administrative operations. The major areas of the research and development program are identified as manned space flight, space sciences and applications, advanced research and technology, tracking and data acquisition, and technology utilization. The key developments of the previous year, pertinent to the present situation, are discussed, and the accomplishments during the past year are indicated. The safety and technological problems are covered, particularly with respect to the Apollo 204 accident. Contractor and supporting activities are described. The cooperation between the Department of Defense, the Atomic Energy Commission, and other federal agencies and NASA is reviewed, along with international cooperation. Emphasis is also placed on the importance of acquiring in the immediate future the sound scientific and technological knowledge for post-1970 space accomplishments. N.E.N.

N68-13406# European Space Technology Center, Noordwijk (Netherlands). Large Satellite Div.

PERT COST AND THE L.A.S.

L. A. Potter Paris ESRO Oct. 1965 11 p

(ESRO-TM(P)-61) CFSTI: HC $3.00/MF $0.65

The application of methods of planning and cost estimating are examined in the context of the Large Astronomical Satellite (LAS), and the problems of progress and cost reporting for a future LAS spacecraft contract are discussed. An examination of the way in which PERT cost may influence this work is made. Author (ESRO)

N68-13434 Joint Publications Research Service, Washington, D. C.

MAXIMUM VELOCITIES OF MOVEMENT OF FISH

U. N. Chestnoy 14 Dec. 1967 9 p Transl. into ENGLISH from Rybn. Khoz. (Moscow), no. 9, 1967 p 22–27

(JPRS-43723) CFSTI: $3.00

Based on the laws of hydrodynamics and the theory of dimensions, a resistance formula for fish in motion is given, as is a formula for the effective power developed by fish to overcome resistance force. In effect, the problem studied is determining the kind of changes in resistance coefficient at various Reynolds numbers. Maximum velocities of the movement of fish are graphed, and peculiar pushing or hurling movements are noted at these maximum velocities. Vertical velocities are not considered to be dependent upon salinity and temperature of the water, although high hydrostatic pressure has unfavorable effects on fish. M.W.R.

N68-13741 Office of Naval Research, Washington, D. C.
THE MAKING OF TEST: THESAURUS OF ENGINEERING AND SCIENTIFIC TERMS Final Report
J. Heston Heald 1967 178 p refs
(Project Lex)
(ONR-26; AD-661001)

The background, operational, and procedural events leading to and included in the building of the Thesaurus of Engineering and Scientific Terms are discussed. The work was performed by the Office of Naval Research, at the request of the Director, Defense Research and Engineering, under a specially established task named Project LEX. Joint working arrangements with Engineers Joint Council resulted in a single Thesaurus for both DoD and EJC. Some resulting facts and figures are reported including recommendations to the Committee on Scientific and Technical Information (COSATI) for changes in the COSATI Subject Category List. Appendixes include authorizing papers, agreements, references material, participants, and joint EJC-DoD conventions for thesaurus building. Results show collection and development of a large data bank, size, and description of the final product as well as computer support and interface to automatic typesetting equipment. Author (TAB)

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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